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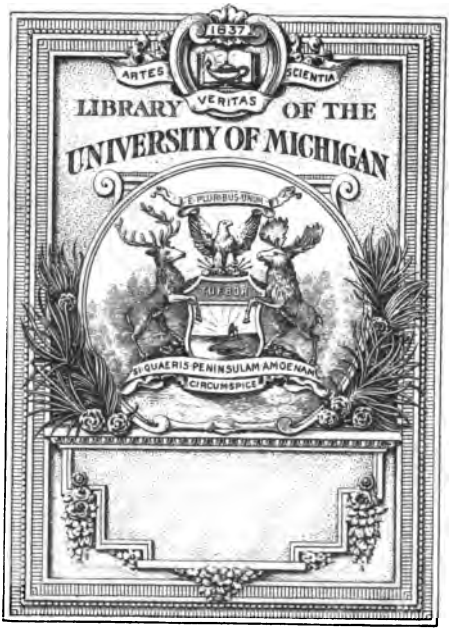
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MANUAL-TRAINING COURSE OF STUDY

AND

TEACHERS' MANUAL

BOARD OF EDUCATION OF THE CITY OF NEW YORK

NEW YORK
PUBLISHED BY J. S. BABCOCK
55 CEDAR STREET
1888

Study and other provisions, in accordance with those views; which course and provisions, when adopted by the Committee, and approved by the City Superintendent, shall be valid as by-laws of this Board as to those schools wherein the same shall be introduced, as hereafter provided in these resolutions.

Resolved, That the said Committee may, with the approval of the City Superintendent, modify the details of said course and provisions, from time to time, as experience may suggest.

Resolved, That on application of any Board of Trustees to said Committee to introduce such course into any school, the said Committee may authorize the substitution in such school of the Course of Study and provisions prepared by them in place of the usual Course of Studies, and the proper Committees shall authorize the expenditures necessary therefor, subject to the rules of the Board relating to expenditures; provided, that until further action is taken by this Board such course shall not be introduced into more than Six Male Grammar Schools and Six Female Grammar Schools, and the Primary Departments and Schools connected with them. A Mixed Grammar School shall be considered, as to this provision, as one Male Grammar School and one Female Grammar School.

Provided further, that the study of the French and German languages, as prescribed by the present Course of Studies, shall not be interfered with.

Resolved, That all by-laws and parts of by-laws inconsistent with the foregoing resolutions be, and the same are hereby, so far as relates to the operation of these resolutions, suspended.

Resolutions Adopted by the Board of Education, December 21, 1887.

Resolved, That the Committee on Course of Study and School Books are hereby authorized and empowered to have printed one thousand copies of the Course of Study prepared by them under resolution adopted October 5, 1887, together with such amendments to the Teachers' Manual and other provisions as they may adopt.

Resolved, That all bills for services of Special Teachers of Manual-Training subjects, for the preparing and furnishing of rooms, and for supplies and materials (except such as can be procured from the Depository), shall be paid on the audit and approval of the Committee on Course of Study and School Books; but no expenditure for such preparing or furnishing of rooms shall exceed the sum of $500, without a

contract being made therefor. All provisions of the by-laws inconsistent with this resolution are hereby suspended.

At a meeting of the Board of Education, February 1st, 1888, *Resolved*, That all applications from Trustees for expenditures for Manual Training purposes shall be made to the Committee on Course of Study and School-Books, which shall have power to act in the same.

PROVISIONS FOR THE CARRYING OUT OF THE MANUAL-TRAINING COURSE OF STUDY.

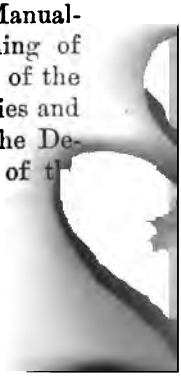
1. The annexed Course of Study, alterations to the Teachers' Manual and other provisions have been adopted by the Committee on Course of Study and School Books, and approved by the City Superintendent, for those schools where the said Course shall be introduced.

2. The By-laws, Rules and Regulations of the Board of Education, including the Teachers' Manual of 1884, are applicable to such schools, as to others, except so far as herein modified.

3. All applications by Trustees to prepare rooms required by the Course, to procure the necessary outfit for the same, and for all Manual-Training supplies, shall be made to the Committee on Course of Study and School Books, which Committee shall have power to approve such applications.

4. Supplies for consumption, not furnished by the Depository, may be procured by the Special Teacher in charge, as required, subject to the approval of the said Committee.

5. All bills for services of Special Teachers of Manual-Training subjects, for the fitting up and furnishing of rooms (which shall be done under the supervision of the Superintendent of School Buildings) and for supplies and material required (except such as are issued from the Depository) shall be paid on the audit and approval of the said Committee.



6. Special Teachers of Sewing, Cooking and Carpentry may be employed, for a specified term of service, by the Trustees on application being made to, and approved by, the said Committee.

7. Such Special Teachers shall be licensed, for the term of service, by the City Superintendent at the request of the said Committee, on passing such examination as he shall prescribe.

8. Such Special Teachers, besides teaching the classes in the Grammar Departments, may be employed to aid and instruct the regular Teachers in both Grammar and Primary Departments in the Manual-Training exercises.

9. The compensation of such Special Teachers shall be as follows:

Teachers of Sewing.....	per hour.
Teachers of Cooking.....	per hour.
Teachers of Carpentry.....	per hour.

10. For all subjects in the Course not treated in this Manual, see the explanations and suggestions contained in the Teachers' Manual of 1884.

11. Upon the introduction of the Manual-Training Course, in the Mechanical Drawing, Geometric problems and theorems, and Work-shop instruction, and in Sewing, the pupils will commence with the requirements for the lowest grade in which the subject is pursued.

CHARLES L. HOLT,
WILLIAM WOOD,
EDWARD J. H. TAMSEN,
DE WITT J. SELIGMAN,
GRACE H. DODGE,
} *Committee on Course of Study and School Books.*

J. EDWARD SIMMONS,
President.

ARTHUR MCMULLIN,
Clerk.

MANUAL-TRAINING COURSE OF STUDY

PRESCRIBED FOR PRIMARY SCHOOLS.

SIXTH GRADE.

LANGUAGE LESSONS.—*Reading*—familiar words, phrases and simple sentences (from blackboard, charts, etc.): *spelling*—familiar words from dictation: lessons on the obvious parts and common uses of familiar *objects*; also, on common *colors*.

FORM AND DRAWING.—*Form*—sphere, cube, square, oblong; position of straight lines—vertical, horizontal, oblique; angles—right, acute, obtuse; surface, face, edge.

Drawing—straight lines—vertical, horizontal, oblique; letters composed of straight lines; angles—right, acute, obtuse; representing (with straight lines) positions of strings, sticks and edges; square and oblong faces of solids; squares and oblongs, from stick-laying.

WRITING.—Short words (from copies on blackboard or chart).

NUMBER.—*Counting*—by ones to 100, by twos and threes to 30; also, counting backward by ones from 10: *adding*—by ones, twos and threes mingled, to 20: *numbers*—to be read to 100 and written to 30.

VOCAL MUSIC.—Simple exercises in singing, to train the pupils in the use of musical sounds.

FIFTH GRADE.

LANGUAGE LESSONS.—*Reading*—from the blackboard, charts, and a First Reader; the *meaning* of phrases and selected words to be associated with their use in the sen-

tences read: *spelling*—words selected from the reading lessons; also, other familiar words: lessons on the obvious parts and uses of familiar *objects*, and on common *colors*, continued.

Form and Drawing.—*Form*—cylinder, square prism, hemisphere, circle, semicircle, triangle; curved surface, curved face, curved edge, curved line; measured lengths, (inches).

Drawing—angles—right, acute, obtuse; triangles; square and oblong faces of solids; curved and straight lines combined; circles and semicircles, by free-hand movement; divide lines into equal parts; draw inch lengths.

Writing.—Short words (from copy).

Number.—*Counting*—by threes, fours and fives to 50: adding—by twos, threes, fours and fives to 30 (on the blackboard and the slate): *subtracting*, by splints, etc., from numbers below 20: *multiplying* two by the numbers below six: *numbers*—to be read at sight from the blackboard, and to be written through three places: *Roman numbers*—through XII; also, their use on the clock face.

Vocal Music.—Continued as in the Sixth Grade, with two or three simple songs, and the scale by rote; represent steps of the scale, and give simple ideas of time.

FOURTH GRADE.

Language Lessons.—*Reading*—through a First Reader, or in an easy Second Reader; the *meaning* of phrases and selected words from the sentences which have been read: *spelling*—words selected from the reading lessons, and other familiar words: lessons on familiar *objects* continued, with obvious qualities added; also, on *color*.

FORM AND DRAWING.—*Form*—triangular prism, rhomb, rhomboid; right, acute and obtuse angled triangles; faces—plane, curved; circle—circumference, diameter; square—diameter, diagonal.

Drawing—square, rhomb, oblong, rhomboid; three kinds of triangles; squares drawn in group, to represent surface of a cube; oblongs and squares in group, to represent surface of a square prism; circle, with diameter; squares, with diameters and with diagonals; parallel lines; front and end of square and of oblong boxes; groups of circles.

WRITING.—Short sentences (from copy).

ARITHMETIC.—*Numeration* and *notation*—through six places: *adding*—single columns of seven figures, including 6, 7, 8 and 9; also *orally*, by sixes, sevens, eights, nines and tens: *subtracting* threes, fours, fives and sixes from numbers below 20: *multiplying* two by numbers below 11: simple practical questions: *Roman numbers*—to include L.

VOCAL MUSIC.—Instruction as in Fifth Grade continued, with additional songs by rote.

THIRD GRADE.

LANGUAGE LESSONS.—*Reading*—in a Second Reader; the *meaning* of phrases and selected words which have been read: *spelling*—words selected from reading lessons, and other familiar words (orally and in writing): lessons on familiar *objects*—continued.

FORM AND DRAWING.—*Form*—cone—base, vertex; pyramid—square, triangular; equilateral triangle; squares on diameters, on diagonals; concentric squares.

Drawing—cylinder, cone, oblong, triangle with two

equal sides; faces of a solid, in group; circles—diameters; parallel lines; squares on diameters and on diagonals—add curved lines symmetrically arranged; two adjacent faces of a solid; common objects—window, door; groups of tablets.

WRITING.—Sentences continued; short words without capitals.

SEWING.—Threading of needle; use of thimble; over-handing.

ARITHMETIC.—*Addition*—three columns of ten figures (including examples with concrete numbers): simple practical questions in addition and subtraction (to be worked without slate and pencil): *multiplication table*—through six times twelve: *Roman numbers*—to include D.

VOCAL MUSIC.—Instruction continued, with the use of staff, clef, notes of different length, time, etc.

SECOND GRADE.

LANGUAGE LESSONS.—*Reading*—through Second Reader; the *meaning* of phrases and selected words which have been read: *spelling*—as in the previous grade: lessons on familiar *objects*—continued.

FORM AND DRAWING.—*Form*—ellipsoid, ovoid, vase; ellipse, oval; quadrant, radius, arc; octagon, hexagon, pentagon.

Drawing—ellipse, oval; vase form, reversed curve; quadrant, radius, arc; octagon, hexagon, pentagon; crosses—Latin, Greek, Maltese, St. Andrew's; circles on half diameters and half diagonals of squares; objects—pitcher, tea-pot, etc.; ornamental groups of tablets.

WRITING.—Sentences continued, with all the capitals.

SEWING.—Hemming; seam sewing; overcasting.

ARITHMETIC.—*Addition*, *subtraction* and *multiplication* (multipliers not to exceed 12), with practical examples: *multiplication table*—completed: *Roman numbers*—to number of the year: *tables*—Federal Money, Time, Liquid Measure and Dry Measure.

VOCAL MUSIC.—Instruction continued as in previous grade; singing notes in groups, pupils to beat time.

FIRST GRADE.

LANGUAGE LESSONS.—*Reading*—of the grade of an easy Third Reader; the *meaning* of phrases and selected words which have been read: *spelling*—as in the previous grade: lessons on *objects*, as in the previous grades, with more complete descriptions.

Geography, without text-books—points of the compass; location and direction of familiar places; elementary terms; shape of the earth, and situation of the principal bodies of land and of water, on globe and on map.

FORM AND DRAWING.—*Form*—construction of forms of regular solids by drawing, cutting, folding and pasting paper, etc.; construction in clay from drawings—steps of stairs, slate-frame, concentric squares, etc.; representation of islands, etc., with clay.

Drawing—circular faces, seen directly and obliquely; objects—oil can, ash can, tea canister, street lamp, kite, etc.; tablets arranged as borders and other ornaments. Draw, as maps, the clay representations of islands, etc.

WRITING.—Brief description of familiar objects; words with capitals; during the latter half of this grade one lesson each week to be written from dictation.

SEWING.—Seams—backstitching and stitching; plain fells; bias fells.

ARITHMETIC.—*Numeration* and *notation*—through nine places: *addition* and *subtraction* continued: *multiplication*—multiplicand not exceeding six figures, multiplier not exceeding four figures: *division*—divisor not exceeding 12: practical examples in the several rules: *tables*—Long Measure, Avoirdupois Weight and Miscellaneous Table, with review of previous grade; simple practical questions.

VOCAL MUSIC.—Instruction continued as in Second Grade; teach the singing of simple tunes in the natural scale by numerals, syllables, letters, la, la, la, and by appropriate words.

GENERAL DIRECTIONS RELATIVE TO INSTRUCTION IN THE SEVERAL GRADES OF THE PRIMARY COURSE.

1. *Order of Exercises.*—In arranging the order of exercises of any Primary School or Department, the minimum time per week shall be as follows: Language Lessons, five and a half hours; Form and Drawing, one and a half hour. Grades I to III, boys, one hour additional for construction; Arithmetic, three and a half hours; Writing, Grades I to III, two hours. Grades IV to VI, one and a half hour; Sewing, Grades I to III, girls, one hour. Opening Exercises, fifteen minutes; Morning Recess, Grades I to III, fifteen minutes; Grades IV to VI, twenty minutes; Noon Intermission, one hour.

The remaining time per week may be distributed at the discretion of the Principal. Opening exercises to commence punctually at nine o'clock A.M., and dismissal at three o'clock P.M. Primary Departments may commence to dismiss at 2.50 o'clock P.M. No class exercises shall take place before nine o'clock A.M., or after three o'clock P.M.

2. *Reading.*—In the reading lessons of each grade the pupils shall be required to state in their own language the subject-matter of the lessons. In connection with lessons in reading and spelling instruction shall be given in elementary sounds, vowel and consonant. The names and uses of the punctuation marks are to be taught as they occur in the Readers. Prose and verse recitations by the pupils of the schools shall be selected from the books upon the supply-list of the Board of Education.

3. *Use of Pencils and Pens.*—The pupils shall not be allowed to write or draw with short pencils; particular care to be taken as to the method of holding both pencil and pen; also as to the position of the body. Writing with the pen shall be begun at least as early as at the beginning of the Third Grade, but should be introduced into lower grades whenever practicable.

4. *Vocal Music.*—The music used shall be such as is found in the books contained in the supply-list of the Board of Education.

5. *Physical Training.*—The pupils shall be exercised daily in such a manner as to expand the lungs, develop the muscles, and impart an easy and graceful carriage to the body. For the attainment of these objects, calisthenic exercises shall be employed, and shall be given at least as often as each half-hour.

6. *Manners and Morals.*—Such instruction should be given daily to the pupils of all the grades as will foster a spirit of mutual kindness and courtesy, a feeling of respect for their elders, of obedience to parents and teachers, and a love of cleanliness, order, law and truth.

7. *Size of Classes.*—No class shall contain more than seventy-five pupils.

TEACHERS' MANUAL.

FORM AND DRAWING.

FOUR OR FIVE LESSONS PER WEEK—TWENTY TO THIRTY MINUTES EACH.

EXPLANATIONS AND SUGGESTIONS.

GENERAL PLAN OF INSTRUCTION.—Develop conceptions of form through seeing objects, handling objects, clay-modeling, stick-laying, etc. Represent conceptions of objects by clay-modeling, paper-folding, and drawing. Teach a child how to see an object before asking him to tell what he sees in it. Telling the child what to see is not the best way to teach him how to see. The child may be told *what to do with an object* as a means of leading him to discover some form or quality of it which ought to receive his careful attention, that he may see and know some essential feature of it; but he should not be told something to be *memorized and recited about the object.*

SIXTH GRADE.

FIRST SERIES OF LESSONS—TIME: TWO MONTHS.

FORM.—*Spheres*—Pupils to hold spheres with thumb and fingers of one hand; with thumbs and fingers of both

hands; to roll the sphere in one hand; to roll it between the hands; to notice that it is round every way, and will roll every way. Teach the pupils to make spheres from clay, rolling them rapidly every way between the hands. Teach *name, sphere.*

Location—Lead the pupils to observe differences in the location of objects, and to apply the terms used to indicate the place of objects; as, *on, under, above, below, in front of, back of, by the side of, in the middle of,* etc.

These exercises may be conducted by means of objects on the desks or on slates.

Position—The teacher to hold a pointer or a long splint in several positions; as, *vertical, horizontal, oblique,* and to train the pupils to hold splints in the same positions.

Repeat these positions in the same order two or three times; then repeat them in a different order until the pupils can correctly and readily represent the positions and name them.

Pupils to use the sticks in forming letters that are composed of straight lines.

DRAWING.—*Lines*—Hold a string on or near the blackboard, *vertically;* show how to represent the string by drawing a line on the blackboard; pupils to draw the line on their slates, holding them in a vertical position.

Hold the string *horizontally;* show how to represent it in this position by a line; pupils to draw the line.

Repeat the holding of the string in the positions already named, and require the pupils to draw lines representing each position several times. Teach the *name* of each position.

When this lesson in drawing is repeated, let two or more pupils hold strings in these positions and the class draw the representing lines on their slates.

Each line should be drawn with free movement several times to secure facility of execution.

Let the pupils draw letters that are formed of straight lines, and tell the position of each line.

N. B.—Teach the pupils how to sit, how to hold the slate and pencil (pencil to be held at right angles with the line drawn); also, teach how to move the hand and the arm.

Second Series of Lessons—Time: Two Months.

Form.—*Cubes*—Pupils to hold cubes in the same manner as they held spheres. Lead them to observe the *surface* of the cube, its *faces;* their *shape*, their *number;* that all the faces are *alike;* then to observe its *edges*, its *corners;* also, to notice that the cube will not roll like the sphere, but that it can be made to *slide* on a side.

Request the pupils to make *spheres* from clay, then to flatten the spheres on opposite sides and thus to form *cubes.*

Repeat this operation of making the cube two or three times during the first lessons.

Teach the *name, cube*, and the use of the terms, *surface, face* and *edge.*

Location—Repeat the exercises for location as in the first series, using both the sphere and the cube, and teach additional terms of location; as, *left side, right side, upper, lower, upper left, upper right, lower left*, etc.

Angles—In this grade use the term, *corners.* Teacher to hold two long splints or pencils so as to represent a *square corner*, and to train the pupils to hold two splints so as to represent it. Teach the *name* of the corner.

With the same objects teach the pupils to represent the

sharp corner and the *blunt corner*. Teach the *name* of each.

Repeat the representations of corners until the pupils can correctly and readily *represent* and *name* each corner.

DRAWING.—*Angles*—Fasten one end of a string at the side or top of the blackboard; then hold the string, by means of a pin or otherwise, so as to form a square corner; show how to represent it by drawing lines; pupils to draw the corner on their slates. Place the string so as to form a *sharp corner;* represent it by lines on the blackboard; pupils to draw the corner on their slates.

Place the string so as to form a *blunt corner;* represent it by lines; pupils to draw this corner on their slates.

Repeat with string and with sticks the shapes of these corners several times and request the pupils to repeat on slates their representations of the corners.

FORM.—*Square*—Review form, position of lines, shape of corners, etc. (use cube and sticks).

Lead the pupils to observe a face of the cube; then to represent with sticks the *sides* and *corners* of the face.

Let them also represent all the faces of the cube and count them. Teach the word *square*, as the *name* of the shape of the faces of the cube.

DRAWING.—Require the pupils to draw lines on their slates to represent the *positions* of those *edges* of the cube which they can see without moving it or themselves; then request them to represent a face of the cube by drawing lines on their slates; also, to draw all the faces of it and to count the squares.

FORM.—*Oblong*—Place before the pupils a cube, a prism, sticks, and square and oblong pieces of paper. Lead them to compare the sides of a cube with the long sides of a square prism; then to represent the sides of each with

sticks; then teach them to fold a square paper so as to represent an oblong.

Teach the *name, oblong.* Fold strips of paper to represent different corners; as, *square, sharp, blunt.*

DRAWING.—Require the pupils to draw the square and the oblong on slates. The lines forming the squares and oblongs should be long enough to secure free movement of the arm—from three to five inches.

Lengths in inches are not required in this grade.

N. B.—The pupils should practice drawing the lines and corners with free movement, to secure facility of execution.

Continue the drawing until most of the pupils have acquired a good degree of facility in the operation.

FIFTH GRADE.

FIRST SERIES OF LESSONS—TIME: TWO MONTHS.

FORM.—*Cylinder*—Place a sphere and a cylinder before the pupils. Request them to hold the sphere in one hand, then in both hands; to hold the cylinder in one hand, then in both hands; to *clasp* the cylinder; to roll the sphere, then the cylinder, and tc tell how each rolls; to compare their surfaces, and to observe that the surface of one is *curved evenly every way;* that the surface of the other is *curved but one way;* that it has *flat faces;* pupils to find other objects of the same shape.

Teach the *name, cylinder.*

Making the Cylinder—Teach the pupils to make the cylinder from clay. As the cylinder is curved only one way, and will roll only forward and backward, the *clay must be rolled only forward and backward* to make a cylinder.

During the process of making the clay cylinder, the ends of it should be struck frequently on the slate or desk to make them flat.

Angles—Teach the *names, right, acute* and *obtuse.*

Location—Repeat the exercises of the Sixth Grade, using the sphere, cube and cylinder as objects to indicate locations described; and add the terms of location, *near together, far apart, opposite, left to right, right to left, side by side, end to end, across, through, face to face,* etc., each as its use becomes necessary.

Edges—Request the pupils to look at the *edges of the cylinder* and at the edges of the cube, and to notice how they differ—one evenly bent, or curved, the other straight.

Teach the *names, curved edge, straight edge.*

Faces—Request the pupils to observe the faces of a cube and the faces of a cylinder, and to tell what difference they see and to tell what the faces of each are like. Teach the *name, circle,* and ask the pupils to find circles in other objects. Teach the *name, circular face.*

Circle and Curved Line—Place a cylinder, a piece of fine wire, a string and a strip of paper before the pupils.

Request them to roll the strip of paper around the cylinder, to slip it off, and, holding it with thumb and finger, to look at the hollow end of the paper; then to bend the wire around the cylinder and to slip it off; then to make the cylinder stand on the slate, and to draw a line around it with a pencil; then to make it stand on the other end, and to draw a line around it, as before. Lead the pupils to see that the edge of the paper cylinder, the bent wire and the two drawn lines are all of the same shape.

Teach the term, *circle,* as the *name* of the shape within the wire and the drawn lines.

Lead the pupils also to notice that the bent wire and the two drawn lines are like the *curved edges* of the cylinder.

Teach the *name, curved line.* Let the pupils represent curved lines in various ways.

DRAWING.—Train the pupils to draw circular forms on their slates with a free movement of the arm—making the curved lines several times in the same place or nearly so, and without taking the pencil off.

Repeat this free-hand drawing until the pupils have gained facility in making evenly curved lines.

FORM.—*Cylinder and Square Prism*—Place a *cylinder* and a *square prism* before the pupils. Request them to hold each in one hand, then each in both hands; and to clasp each; lead them to notice that one only will roll, that both will *slide* and *stand.* Let them compare the surfaces and then the faces, noticing that one has a *part of its surface curved* and *parts of it flat;* that the other has *only flat faces;* that one has *straight edges* and the other *curved edges;* that one has two circular faces and the other two square faces and four oblong faces. In each case of the handling and observing of the forms, request the children to *tell what they see, feel* or *find.* Do not tell them, first, what to find.

Modeling the Square Prism—Direct the pupils to make cylinders from clay, as before; then to flatten them lengthwise on opposite sides, so as to make four oblong faces; and to keep the ends flat to form the square faces.

Let the pupils compare the clay prism with the model of wood, and correct the errors. Teach the *name, square prism.*

Teach the pupils to represent with sticks the ends and the sides of the square prism; let them count the squares and

the oblongs. Let them fold *paper* to represent the several faces of this prism.

DRAWING.—Request the pupils to draw the separate faces of the square prism. Let them draw a line across an oblong, so as to form a square, and draw a line across a square, so as to form oblongs. Draw the lines long enough to secure free arm movement.

SECOND SERIES OF LESSONS—TIME: TWO MONTHS.

FORM.—*Sphere and Hemisphere*—Place a *sphere* and a *hemisphere* before the pupils. Request them to hold both in various ways, to compare their shapes, to notice the surfaces of each and the face of one; to compare this face with the ends of the cylinder; to find same shape in other objects; use the *names*, *plane face*, *curved face*, *hemisphere*.

Modeling a Hemisphere—Require the pupils to make spheres from soft clay; then teach them how to hold the clay sphere in the left hand, and, with a thin, stiff card to *cut it into halves*, thus forming hemispheres. Let the pupils compare these with the model hemisphere of wood, and correct defects. Use the *name*, *hemisphere*.

Location—Put before the pupils several forms, and direct them to place each as a location is described; then let pupils tell where each object is placed. Let pupils ...cts, and describe the location of each.

terms of location, as necessary.

...icircle—Place a *circle* and a *semicircle* ...ther with pieces of paper of each of ...ils compare them; then direct ...to halves, and to compare it ...n the folded paper and ...l.

Teach the *name, semicircle*, for half of the circle.

Let the pupils represent semicircles with sticks and bent wire.

DRAWING.—Pupils to draw curved lines and straight lines in combination, so as to form semicircles; also draw circles, squares and oblongs. Request the pupils to draw, from memory, each kind of *angle*, right, acute, and obtuse.

FORM.—*Square and Triangle*—Place before the pupils square and triangular prisms; also triangles of three kinds, and a square. Request the pupils to compare the square and the triangles with the faces of the prisms. Request the pupils to tell what kind of angles each three-sided form has.

With *paper squares* teach the pupils to fold squares from corner to corner, so as to make forms with three corners.

With *strips of paper* teach the pupils to make, by folding, the different corners found in the forms before them; and require them to tell the kind of angle that each corner represents.

Require the pupils to count the angles and sides on each of the plane forms before them; also on the faces of the prisms. Teach the *name, triangle*, for all plane forms with three sides and three angles.

FORM.—(*Exercises Leading to Measured Lengths*).—*Fold squares* from side to side, into *two equal parts;* again fold them from side to side, into *four equal parts.*

Fold strips of paper into *two equal lengths;* into *four equal lengths.* Find half of the length of a string or a strip of paper; find a quarter of the length of a string or of a strip of paper.

Divide lines into *two equal parts;* divide lines into *four equal parts.* Find half the length of a line; find a quarter of the length of a line.

Teach inch length with inch squares and inch cubes.

Extend measured length to four inches.

DRAWING.—Request the pupils to draw triangles with each kind of angle. Let them count all the right angles, all the acute angles, all the obtuse angles, and tell how many they find of each kind.

Let them draw two-inch squares; oblongs, two inches by four inches.

FOURTH GRADE.

FIRST SERIES OF LESSONS—TIME: TWO MONTHS.

FORM.—*Triangular Prism*—Place before the pupils *a cylinder*, a *square prism* and a *triangular prism*. Review the essential features of the cylinder and the square prism by winding or folding a strip of paper around each; and then slipping off the strip and holding it by the thumb and finger so as to represent the *surface* and the *faces* of the form. Request the pupil to hold the *solid* and the *hollow form* side by side, and to tell how they resemble each other and how they differ. The paper forms may be called, respectively, *hollow cylinder*, *hollow prism*.

Having finished this review, request the pupil to examine the *triangular prism;* to clasp it; to notice the shape and the number of its faces; its edges; to tell the shape and number of its *side faces;* of its *end faces*. Place the *triangular and the square prisms* side by side; end to end; lay the square prism on one of its sides and place the triangular prism upon it; require the pupils to tell what the two prisms, when placed together, are like. Teach the *name, triangular prism*. When this exercise is reviewed, add to the forms the right angled triangular prism.

Modeling the Prisms—Require the pupils to make a cylinder from clay, and then from that form to make a *square prism* by flattening the cylinder on its opposite sides.

Make another cylinder of clay and flatten it on three sides to form a *triangular prism* like the model before the pupils.

Plane Forms—In developing conceptions of a *rhomb*, use a square, a rhomb, and sticks of equal length. Request the pupils to examine the two forms, and then to represent each with splints; lead them to compare their sides and their angles, and to tell what they see. Teach the *name, rhomb.* Pupils to *draw* squares and rhombs—sides three inches—to cut them out and to fold them on the diagonals.

Rhomboid—In developing conceptions of a *rhomboid*, use an oblong, a rhomboid, and sticks of two lengths. Request the pupils to examine the two forms and to represent each with splints; to compare their sides, and their angles, and to tell what they see. Teach the *name, rhomboid.* Pupils to *draw* the oblong and the rhomboid—sides two inches by four inches.

Review these forms by placing before the pupils a square, rhomb, oblong and rhomboid. Require them to find the forms that have like sides; then those that have like angles. Give the pupils pieces of paper to be folded so as to represent each of these forms. Also, use the same plane forms prepared and in colored paper. Require the drawing of these forms from memory.

Kinds of Triangles—Place three kinds of triangles before the pupils. Require them to tell the name of each angle as it is pointed at; also, to tell which kind of angle can be found in every triangle; to tell which kind can be

found in only one triangle. Teach the *name, right angled triangle*, for the triangle with a *right* angle; *obtuse angled triangle*, for the triangle that has an *obtuse angle; acute angled triangle*, for the triangle that has *all of its angles acute.*

Pupils to form each kind of triangle with splints; also, by folding paper.

DRAWING.—Draw each of the triangles, the rhomb and rhomboid, with no side less than three inches. Draw a square; then an oblong equal to two such squares; draw a right angled triangle equal to half of the square. Draw *obtuse* and *acute* angled triangles equal to half of the rhomb.

Continue to draw circular forms, with free arm movement.

Draw groups of three and of four circles in different positions. *Also, draw the front and the side of square and of oblong boxes. Pupils should practice drawing forms on paper.*

SECOND SERIES OF LESSONS—TIME: TWO MONTHS.

FORM.—(*Further Development of Conceptions of Surfaces and Faces*).—*Of Cubes*—Place before the pupils a *cube*, and also paper *tablets* for all the faces. Let them fit a tablet to each face of the cube, and then arrange them in a group in such position that the tablets may be easily folded on the several faces of the cube.

Now require the pupils to draw on paper the faces as grouped for folding on the cube, then to cut the group out and fold it around the cube.

Of Prisms—Place before the pupils a *square prism* and *tablets* for the square and the oblong faces. Let them fit

a tablet to each face of the prism, and then arrange them in a group in such positions that the tablets may be easily folded on the several faces of the prism.

Now require the pupils to draw on paper the faces of this prism as grouped for folding, then to cut out the group and to fold it around the prism.

Proceed in the same manner to develop conceptions of the surfaces and faces of the *triangular prisms*.

By these exercises conceptions of a complete surface composed of several faces will be developed.

Of a Cylinder—Place before the pupils a *cylinder*, *circular tablets*, and a *strip of paper*. Let them fit the strip of paper and the tablets to the cylinder, and then arrange the paper and the tablets so that they may be easily folded on the cylinder.

Now require the pupils to draw on paper the entire surface of the cylinder; then to cut it out and fold it around the cylinder.

Circumference and Diameter of a Circle—For developing conceptions of circumference and diameter, use a *cylinder*, *circular tablets*, *paper circles*, *strips of paper*, *strings* and *sticks*.

Wind a strip of paper around the cylinder and cut it so that the ends will meet; wind a string around the cylinder and cut it so that the ends will meet. Place a string around a circular tablet and cut it so that the ends will meet. Lead the pupils to see that the strip of paper and the strings show how far it is around the cylinder and the circle; then teach them that the line around the form is called its *circumference*. Let the pupils find the circumference of a cup and of other objects having circular bases or sections.

Require the pupils to fold a paper circle into ha

and to notice that the crease extends *from side to side through the middle.* Fold the circle into halves again, so that the second crease shall cross the first one at right angles. Teach the pupils that every crease of the circle from one side through the middle to the opposite side represents a *diameter* of the circle. Let the pupil find diameters of the ends of a cylinder, and of paper circles of different sizes.

Use colored paper during part of the exercises with plane forms.

Diameters and Diagonals of Squares—Place before the pupils *square tablets* and *square* pieces of *paper.* Let them fold a paper square into halves, from side to side; then let them fold it into halves again, from side to side, so that the second crease shall cross the first one at right angles. Teach the pupil that each of the *creases* represents a *diameter* of the square: the diameters connect the middle points of the opposite sides of the square. Let the pupils find a diameter of the square tablet, of a face of a cube, and of other objects.

Let the pupils fold a square paper from a corner to the opposite corner, and then fold it through the other opposite corners. Teach them that a line from a corner of a square through the middle of it to an opposite corner is called a *diagonal* of that square. Request the pupils to tell where the diagonals meet, or cross each other. Tell the pupils that the point where the diagonals meet is called the *center* of the square; that the point where the diameters of a circle or of a square meet is called the *center* of that circle or square.

Drawing.—Require the pupils to draw squares and to represent their *diameters;* to draw other squares and to represent their *diagonals.* Also, to draw circles and to

represent their *diameters*. Also, to draw parallel lines in different positions, *vertical*, *horizontal*, *oblique*.

THIRD GRADE.

FIRST SERIES OF LESSONS—TIME: TWO MONTHS.

FORM.—*Cone*—Place before the pupils a *cone* and a *cylinder*. Require them to handle each, as with solids in previous grades; to feel the curved surfaces, and to tell how they differ; to notice that both solids have circular faces; that the curved surface of one is straight from end to end and that its ends are of equal size; that the curved surface of the other *tapers directly to a point* at one end; that one will *stand* on either end, the other, on one end only. Teach the term, *base*, as the *name* for that face of an object on which it stands, and the term, *vertex*, as the *name* of the point at the top. Teach the *name*, *cone*.

Pupils to name objects having a similar shape; as, *top*, *sharpened pencil*, etc.

Modeling a Cone—Before modeling the cone let the pupils roll the cylinder and the cone on a slate and notice how each moves, and thus learn how to roll the clay when forming the cone. Make a clay cylinder and form the cone from it by pressing one end and by rolling; or make it by shaping the clay into a tapering form, then rolling it.

To develop fuller conceptions of the curved surface of a cone, let the pupils roll and wrap the model closely in a piece of paper, and then cut the paper so that it will fit the curved surface. Many cone shapes may easily be made from paper semicircles.

DRAWING.—Place a *cylinder in front of the class*, in a

position level with the eyes of the pupils, so that the solid will be seen as an *oblong*. Require the pupils to hold their *slates in a vertical position*, resting the bottom on the desk, then to draw lines to represent the shape of the cylinder *as they see it;* then to place the slate on the desk in the usual position for drawing, and to draw the cylinder again as they see it.

Next place a *cone in front of the class*, in a position level with the pupils' eyes, so that they shall see the cone as a *triangle*. Require them to hold their slates in a vertical position, as before, and to draw lines to represent the shape of the cone *as they see it;* then to place the slate on the desk and to draw the cone again as they see it.

Now direct the pupils to draw an *oblong* with sides two inches by four inches; and an *acute angled triangle* with two sides of four inches, and the other side two inches. Let the pupils compare these forms with those drawn previously to represent the cylinder and the cone.

FORM.—*Pyramids*—Place before the pupils *a cone and a square pyramid; also four triangular tablets and a square one* to represent the five faces of the pyramid. Let the pupils look at the cone, feel it, move it; then look at the pyramid, feel it, move it, and notice wherein the two differ, and, also, wherein they resemble each other. They should notice that both taper to a point; that both will stand; that one has a circular base, and one a square base; that one has a curved surface tapering directly to a point; that the other has equal flat faces all tapering to the same point, called the vertex. Teach the term, *pyramid*, as the name of this new solid. Let the pupils fit the several tablets to the different faces of the pyramid.

For the purpose of teaching the *kinds of pyramids*,

place before the pupils a *square pyramid and a triangular one*, with tablets to fit all the faces of both. Let the pupils feel each pyramid; compare their bases, their other faces and the number of these faces, and fit the several tablets to the different faces. Teach the term, *square pyramid*, as the *name* of the one with a square base, and the term, *triangular pyramid*, as the *name* of the one with a triangular base.

Call attention to the *equal sides* of the triangles used; teach the term, *equilateral triangle*, as the *name* for the triangle having all its sides equal.

To develop fuller conceptions of the surfaces of these pyramids, let the pupils fold a piece of paper around each, creasing the paper at the edges of the pyramid; then let them open the papers and notice the shape of each face and the number of its triangular faces. These papers may then be cut so as to leave only the triangles joined at their sides. Now lead the pupils to notice the shape of the paper representing the entire surface of each pyramid.

Modeling Pyramids—The pupils may make cones of clay, then flatten the opposite sides to form the square pyramid, as was done with the cylinder to form the square prism; or they may first shape the pyramid by gentle pressure with thumb and fingers, then lightly tap the sides to give them smooth faces. Pupils to compare the clay pyramid with the model, and to correct errors.

Proceed in a similar manner to model the *triangular pyramid.*

Drawing.—Place the *square pyramid* before the pupils and require them to draw the front face; then to turn the pyramid a quarter of the way around and draw the next face; and continue to turn thus and to draw the

other triangular faces. Next let them lay the pyramid on a triangular face and draw its base.

Now, let the pupils place the tablets side by side, so that the long sides shall coincide as in the paper surface previously formed, and then draw the triangular faces of the square pyramid, side by side, on paper, in a shape that may be cut out and folded around this solid. Proceed in a similar manner to draw the faces of the triangular pyramid; to represent them with tablets; to cut out the paper in the shape formed by the tablets and to fold it around this solid.

Circles—Let the pupils practice drawing circles with free movement. Let them also draw diameters of the circles.

Conceptions of Length—Teach the pupils to fold strips of paper into *three equal lengths*, also into *six equal lengths*. Teach them to divide lines into three equal parts, and into six equal parts. Let them place dots two inches apart, three inches apart, four inches apart, and connect them with straight lines.

SECOND SERIES OF LESSONS—TIME: TWO MONTHS.

FORM.—*Squares on Diameters and Squares on Diagonals*—Place before the pupils pieces of square paper. Direct them to fit one pair of the opposite edges of one square together, then to fold and crease it; then to place the other pair of opposite edges even, and crease at the fold as before—thus representing the *diameters of the square.*

Direct them to fold another square from corner to corner so as to represent both of its *diagonals.* Now lead the pupils to notice how the two squares are folded, and

teach them the term, *square-on-its-diameters*, as the *name* of the square in which its diameters are represented; also, teach the term, *square-on-its-diagonals*, as the *name* of the square in which its diagonals are represented.

Next require the pupils to represent *squares on diameters* by folding paper; then to represent *squares on diagonals* by folding paper. Now direct the pupils *to draw* two squares—one representing *a square on its diameters*, and the other representing *a square on its diagonals*. Next teach them to draw lines to represent *diameters*, and then to draw the sides of the square around the diameters; also, teach them to draw lines to represent *diagonals*, and then to draw the sides of the square, inclosing the diagonals.

Concentric Squares—For developing conceptions of concentric squares, place before the pupils paper squares of different sizes and colors. Require them to fold two or more squares of different sizes and colors, on their diameters, and thus to find their *centers;* also to fold two or more squares of different sizes and colors, on their diagonals, and thus to find their *centers*. Now let the pupils place large and small squares, folded on diameters, together, so that the creases and centers shall coincide; also let them place together large and small squares that are folded on diagonals, so that the creases and centers shall coincide. Lead the pupils to notice that in each case the centers of the squares coincide, and that all the corresponding sides are parallel; then teach the term, *concentric squares*, as the name of two or more squares in either of the arrangements represented.

Drawing.—Require the pupils to draw parallel lines in different positions; also, to draw *concentric squares* with the *diameters* represented; with the *diagonals* repre-

sented; to draw *squares on diameters; squares on diagonals;* to add to the diameters and to the diagonals symmetrically arranged curved lines.

From Objects—Direct the pupils to lay a *square prism* on its side, with an end toward them, to fit on it a triangular prism, and then to draw the end view of the combination.

Request the pupils to draw common objects; as, the lower half of a window, with the panes in proper shape; also a door with its panels.

Place before the *class*, on a level with the eyes of the pupils, a large *square prism* with one face directly toward them. Direct them to hold their slates in a vertical position while drawing the face—then the teacher may turn an *edge* of the prism toward the pupils so that the *two* faces seen will appear equal, and request them to draw the two faces together, *as they see them*—first holding the slate on the desk in a *vertical* position; then to repeat the drawing of the faces with the slate or paper in the usual position.

After the pupils can draw the two faces of the square prism fairly well the teacher may place *before the class* a large *square pyramid*, with one face fronting the pupils, and require them to draw that face; then turn the pyramid so that two faces can be seen distinctly by the pupils, as in the case of the square prism, and request them to draw both faces together, *as they see them.*

Use of Tablets in Drawing—Give each pupil two square, two oblong and two triangular tablets, and let each arrange these in a group which he may think would make a good one to draw; then let him draw the group on paper, representing all the edges of the tablets. Then let him make other combinations.

Boxes—Request the pupils to draw, on paper, squares

with three-inch sides in a group that may be cut out and folded into the shape of a cube. Let them draw oblongs and squares in a group, cut out the group and fold it into a box shaped like a square prism. Teach them how to draw, to cut and to fold paper for a box with a bottom four inches square and with sides two inches high, without a cover. Let them also draw and make similar boxes of other sizes.

SECOND GRADE.

First Series of Lessons—Time: Two Months.

Form.—*Ellipsoid*—Place before the pupils a *sphere*, an *ellipsoid*, also *circle tablets* and *ellipse tablets*. Require them to compare the sphere and the ellipsoid and to tell how they resemble each other, and wherein they differ. Let them trace the surface of each with the finger touching it and then represent each by tracing its shape in the air with the finger. Next let them compare the circle and the ellipse with these solids, and also with each other. Teach the *name*, *ellipsoid*, for the new solid, and the *name*, *ellipse*, for the new plane form.

Modeling the Ellipsoid—Request the pupils to make a sphere from clay; then to hold the *ellipsoid* between both hands, and roll it slowly, to learn how it rolls. Now they may take the clay sphere and change it into an ellipsoid by rolling it between the hands. This solid may now be cut into halves, lengthwise, and the plane faces compared with an ellipse-shaped tablet.

Drawing.—Let the pupils try to draw the form of the ellipse with the solid and the plane forms before them. Direct them, when drawing this form lying on its side, to

hold the pencil in the same position as for drawing a horizontal line; but, when drawing it standing on one end, to hold the pencil in the position for drawing vertical lines.

Practice drawing the circle and ellipse forms with free movement.

Ovoid—Place before the pupils a *sphere*, an *ellipsoid* and an *ovoid*, together with *circle*, *ellipse* and *oval tablets*. Let the pupils feel each of the three solids with one hand, with both hands; trace their forms with the finger; notice that the surface of each of these solids is curved differently from the other two. Let them roll each and observe how it rolls—whether evenly every way, or in two ways (forward and backward) with a wabbling movement, or in a circular course with a slightly wabbling movement. Let them compare the solid forms with the plane forms—circle, ellipse, oval; let them also compare the plane forms with one another, and notice differences in the curved ends and sides of the oval and ellipse. Teach the term, *ovoid*, as the *name* of the egg-shape solid, and *oval*, as that of the plane form.

Modeling the Ovoid—Let the pupils feel the ovoid with the fingers, roll it between the hands, then make a clay sphere, and modify its shape to that of an ovoid by rolling it between the hands.

Let the pupils cut a sphere, a cylinder, a cone, an ellipsoid and an ovoid so as to get a circular section in each.

Paper Folding; to Develop Quadrant, Radius and Arc.—Give the pupils paper circles; review circumference and diameter; direct the pupils to fold the circles so as to develop the conception of a *quadrant*, as a quarter of the circle; of a *radius*, as one half of the diameter; and of an *arc*, as a part of the circumference. Teach terms, *quadrant, radius, arc.*

DRAWING.—Let the pupils draw the sphere as an *apparent circle*, an ellipsoid as an *apparent ellipse*, the ovoid as an *apparent oval*, with free movement. Direct them to draw a circle four inches in diameter, and to draw diameters dividing it into semicircles and into quadrants.

Teach the pupils to represent two diameters of a circle at right angles, and to draw a circle around them. Require them to draw a square, and to draw within it a circle touching the four sides of the square; also, to draw a square with its diameters, and to draw a circle on each half diameter; also, to draw circles on the halves of diagonals.

Teach the pupils to draw circles and rhombs, and to add to them straight and curved lines symmetrically arranged.

Common Objects—Place in front of the class, on a level with the eyes of the pupils, a common object the outline of which can be represented by straight lines; as, a tin cup, pail, tumbler, etc., and require the pupils to draw it, holding the slate in a vertical position, then in the usual position, when repeating the drawing. The same objects are to be drawn on paper also.

Let the pupils place tablets, splints and curved wires in ornamental groups, and then draw these groups. Let them draw the end view of a house, with windows and a chimney; also, a front view with a door, windows and two chimneys.

Let them also, by drawing and by cutting and folding paper, make boxes of different shapes and sizes. Encourage them to bring specimens of their home-work in ornamental drawing and in box-making.

Second Series of Lessons—Time: Two Months.

Form.— *Vase Form*—Place before the *class* a large *cone* and a large *vase form*, and before the *pupils* a small *cone*, *ovoid* and *vase form*. Let each pupil move a finger down the sides of the curved forms and observe how they differ; then move a pencil between the eye and the form, tracing in the air the shape of the sides of each.

Modeling Vase Forms—Let the pupils take a piece of clay and by rolling, pressing and turning it in the hand model a vase form.

Drawing.—Let the pupils trace one side of the *vase form* with the finger of one hand, and the opposite side with the finger of the other hand; then trace both curves at the same time. Lead them to notice that each line which represents a side of the vase form curves in two ways; i.e., it has *reversed curves*. Now direct the pupils to hold the slate in a vertical position and to draw the curved lines that represent the sides of this form; then to place the slate in the usual position and draw both of the reversed curve lines several times with free movement. Let these *reversed curves* be drawn on paper also.

Now place before the *class* a large *vase form*, on a level with the pupils' eyes, and direct them to hold their slates in a vertical position, and to represent the outline of this form as they see it. Then let them draw the outline on paper.

Objects—Place before the *class*, on a level with the eyes of the pupils, an object to be represented with *reversed curves;* as, a *pitcher* or a *tea-pot*, and let them draw the outline as they see it.

Form.—*Plane Forms*—To develop ideas of plane

forms having equal sides and more than four equal angles, give the pupils paper circles and paper squares to be folded; also, forms made of paper to represent a *pentagon*, a *hexagon* and an *octagon*. These forms may be easily represented as found in prisms with five sides, six sides, etc., by folding a strip of straight-edged paper twice around a square prism, creasing the paper at each edge of the prism, then removing and arranging it so as to form a hollow prism with *five sides*, the end of which will represent a *pentagon*; then by arranging this folded strip of paper so as to form a *six-sided* prism the end of which will represent a *hexagon*, etc.

Direct the pupils to fold a square paper into eight equal triangles about its centre, and, without further folding, to cut off the outer end of these triangles, so as to leave a packet of eight acute angled triangles with their longer sides equal. Open this folded paper and an *octagon* will be seen. Teach its *name*.

Direct the pupils to fold a circle into halves, and then to fold the halves so that each is divided into *three equal parts* (sectors); then to cut off the curved end of this form, so as to leave six equilateral triangles. Open this folded paper and a *hexagon* will be found. Teach its *name*.

Repeat these foldings of octagons and of hexagons two or three times.

Drawing.—Let the pupils arrange tablets of different forms in ornamental groups, and draw the groups on their slates. Teach them to draw octagons and hexagons, and to add to each straight and curved lines symmetrically arranged.

Let them draw lattice work, gates, picket fences, etc. Teach them to arrange straight and curved lines in

ders; to draw in oblongs and in squares the *Latin cross*, *Greek cross*, *St. Andrew's cross*, and *Maltese cross*.

DRAWING AND MAKING.—The drawing and the cutting and folding, etc., may be continued for the making of boxes, etc. Let the pupils draw and cut from paper each of the four crosses previously drawn.

FIRST GRADE.

TRANSPOSITION OF ORDER OF PROCEDURE.—In all the foregoing grades of the Primary Course, discipline in the *perception* and *conception* of forms, through the agency of the senses, has preceded *practice* in *representing* those forms by *drawing*. This discipline has throughout been so combined and interwoven with manipulative exercises in *construction*, by the use of cords, splints, paper, clay, etc., that each of the two elements, the conceptive and the constructive, forms an inseparable adjunct or counterpart of the other.

All of the simple geometrical forms and elements, the sphere, cube, prism, cylinder, cone and pyramid, with their several surfaces, faces, lines, etc., have now been sufficiently analyzed, and the pupil is prepared for their further and wider application. This advance requires a change in the order of the two general departments of the discipline. *Drawing from objects* now becomes the *first stage* of the work, and *construction* and *representation* in paper, wood, clay, metal, etc., *based directly on such drawings*, the *final and great element of the discipline*.

This new order of procedure runs through the first Primary Grade and throughout the Grammar School Grades.

First Series of Lessons—Time: Two Months.

Drawing.—*Arranging Tablets*—The purpose being to make designs to be drawn, give to each pupil a sufficient number of tablets of two or more shapes; as, *squares, oblongs, triangles, circles, semicircles, ovals, ellipses*, etc. Direct the pupils to arrange the tablets in groups for borders and then to draw the borders on paper. Let them arrange the tablets in ornamental groups and draw them. Give the pupils oblongs and squares; direct them to represent with these the end view of three steps of a flight of stairs and then to draw the same. Also, let them form other objects.

Form.—*Making from Clay*—After the pupils have drawn the end view of steps in a flight of stairs, let them form a cube from clay and make the steps on one side of it, using the spatula to shape them. Other simple designs may be made with tablets, be drawn, and then be made from clay.

Let the pupils model from clay a small slate-frame, about four inches by two, using the spatula.

Direct them to draw concentric squares and to make them of clay. They may also draw and make concentric circles.

Regular Solids; Representing by Paper Forms—Require the pupils to draw on thick paper, and to cut, fold and paste the same, so as to represent each of the following regular solids: *cube; prisms—square and triangular; pyramids—square and triangular; prisms—with five, six and eight sides; cone; cylinders—long and short; boxes—square, oblong and round;* etc.

Second Series of Lessons—Time: Two Months.

Drawing.—*Circular Faces*—Direct the pupils to place a cone on its side with the circular face toward them, then to draw the face as they see it. Let them insert the point of the cone in a piece of clay so that it will stand with its circular face turned away far enough for them to see it as a narrow ellipse, then require them to draw this *ellipse*. Then let them place the cone so that its circular face shall be at the top and horizontal, and require them to draw this face as they see it—as a wider ellipse; then require the pupils to draw two lines from this ellipse downward, to represent the tapering of the cone.

Next let them place the cone on its base and require them to draw its outline as they see it.

Request the pupils to place a *cylinder* near the front of the desk, and to draw its top view; then to place the cylinder near the back of the desk, and again draw its top view.

For leading the pupils to perceive that the *circular base* and the *circular top* change in appearance as the position in which they are looked at changes, place before them a glass tumbler with parallel sides, or a chimney of an argand burner; let them look at the top and at the base when it stands near them; also, when it stands farther away.

The elliptical shapes which a circular face assumes, when viewed at different angles and distances, may be further illustrated by holding before the class a common hoop, in different positions—so that they may see it as only a straight line—a narrow ellipse—a wider ellipse—still wider and finally a circle.

Let the pupils draw these different ellipses as they see them.

Drawing from Objects—Request the pupils to draw an *oil can, an ash can, a tea canister, a street lamp, a kite, two telegraph poles and the wires between them.* These objects may be drawn first as home-work, and re-drawn in school for correcting errors.

FORM.—*Short Cylinders*—Place several cents in a column to represent approximately a cylinder: represent a shorter cylinder with fewer cents, and a still shorter cylinder with circular tablets; show, also, that a cent or a tablet is itself, approximately, only a very short cylinder.

DRAWING.—Let each pupil stand a *cone* on a *cube* and then hold them off from him so that he may see the cube as a *square* and the cone as a *triangle:* then let him *draw this combination* without respect to perspective effects.

Proceed in a similar manner with a *pyramid* and a *cube*, a *cylinder* and a *cube*, and a *sphere* and a *cube.*

ARITHMETIC.

SIXTH GRADE.

COUNTING AND ADDING.—A child's earliest notions of numbers are derived intuitively from handling *like objects.* Very often, if a young child, ignorant of the number, *three*, should have three marbles just alike, it would be found to be conscious of the fact that one of them had become missing. Hence, in learning to count by *ones*, the pupils should count their fingers, splints, balls on the numeral frame, marks on the blackboard, panes of glass, rows of pupils, pupils in a row, etc.

To teach the pupils to count by *twos*, the teacher she

have them arrange splints by twos, or she should make the groups in groups of two on the blackboard. After the pupils have learned to count the splints, etc., previously grouped, let them count by twos at the same time that they are making off the successive groups. Having thus learned to count 2, 4, 6, etc., they should be taught in like manner to count 1, 3, 5, etc.

The same general method of procedure should be followed in teaching the pupils to count by *threes:* 3, 6, 9, etc.; 1, 4, 7, etc.; 2, 5, 8, etc.

[illegible] counting objects necessarily precedes the [illegible] abstract numbers and is essential to the proper [illegible] them, the mind of the child soon reaches [illegible] development in which the thought of the [illegible] the idea of the *numbers* remains [illegible] important that teachers should employ [illegible] as will lead most easily to the [illegible] the fundamental facts and [illegible] practice of giving to [illegible] elementary instruction [illegible] teachers gener[illegible]

will lead the pupils to see that *the number of facts to be committed to memory is really small*, and that these few facts may be used readily to build up larger and larger numbers. *The teacher should make frequent tests of the pupil's remembrance of these separate facts: mere rote exercises in counting should not be allowed.*

Upon the pupil's remembrance of these separate facts depends his ability to *add:* if time enough be given, any pupil who can count by ones can *count up* several numbers; but that is not *adding.*

A pupil that remembers the *successive results in counting by twos* can readily add a column of twos; under similar conditions he can add a column of threes. The *greatest* difficulty is found when the numbers are mingled, because this is the test of the remembrance of the separate facts. Let the instruction in *adding* (orally and in writing) accompany that in *counting.* When the pupils have advanced a little way in counting by ones, let the teacher make a few marks (1's) in columns and have the pupils add them. Also, let the teacher give questions orally; as, One cent and one cent? Two cents and one cent? Etc., etc.

When the pupils are well advanced in counting and adding by *twos*, give them exercises in adding ones and twos *mingled*, beginning with very short columns. Let them, in similar manner, learn to add threes and, also, combinations of threes, twos and ones.

In giving out *two* numbers to be added orally, vary the form occasionally by giving the larger number after the smaller; as, Three splints and five splints? Etc., etc.

In the latter part of the term let the pupils add columns of figures on their slates.

When the pupils are familiar with counting and adding

threes; when they have learned the sum of four and four, and of five and five, they have learned to multiply four and five by two. Let the pupils place *twos* in columns—first *two* twos, afterward *three*, *four* and *five*: then let the pupils find the sum of each. From the first column it will appear that *two* twos are *four*; from the second, that *three* twos are *six*; from the third, that *four* twos are *eight*; and from the last, that *five* twos are *ten*. Placing *two* threes in a column and adding, it will appear that *two* threes are *six*, the same result as that for *three* twos. Similarly, *two* fours give the same result as *four* twos, and *two* fives the same result as *five* twos. Let the pupils memorize the facts thus developed. Finally, ask such questions as the following: How many twos are in six? How many in ten? Fours in eight? Etc., etc.

READING AND WRITING NUMBERS.—In the Sixth Grade the pupils learn to read numbers to 100 and to write them to 30: in fact, although not *required* to do so, pupils, when tested toward the end of that grade, are found to be able to write quite accurately all the numbers to 100. In the Fifth Grade, just as in the Sixth, the numbers are to be spoken of as *wholes*; as, for instance, 237—not 2 hundreds, 3 tens and 7 units. The "teens," which prove such a "stumbling block" to pupils in the Sixth Grade, should receive particular attention in the present grade. The method of instruction by *grouping numbers* should be employed in teaching the pupils. The first group should consist of the numbers from 1 to 99 (inclusive). The second group should consist of the *hundreds*, 100, 200, 300, etc. Before considering a third group the teacher may show the pupils that 1, 2, 3, etc., may be written 01, 02, 03, etc.: by so doing the teacher, probably, will render easier the writing of such numbers as 101, 305, etc.

Let the teacher write 100 on the blackboard and teach the pupils the number it represents. Then let her write 200 under it and ask the pupils what number they think it stands for. When the pupils have learned 200, some pupil may be asked to write under it the figures for 300; and so on. After the pupils have learned to read and write the second group, in order and out of order, the teacher may commence teaching the third group: this should consist of the combinations of the numbers in the first group with those in the second group.

Let the teacher write 100, and under it, 101, 102, 103, etc., through 110: then let the pupils tell what numbers they think these figures represent. When they have learned to read these numbers, let some pupil try to write 111 and 112 under them. In this way lead the pupils to read and write other numbers, such as 129, 175, 263, 495, 206, 518, etc. It is not necessary that the numbers be taken *consecutively* through the first hundred and then through the second and the third, etc.

If the pupils be encouraged to do their own thinking they will soon find that what is seen in *any hundred* finds its corresponding expression in *each of the others*. In giving pupils practice in reading and writing numbers, drill particularly on the numbers that present difficulties, such as 107, 703, 517, 419, etc.: such numbers as 642, 839, etc., are very seldom read or written incorrectly, if the class be at all well taught.

Roman Numbers.—It is well that the pupils should learn first the value of I, *one;* of V, *five;* and of X, *ten*. When the values of these letters have been taught, then teach the numbers in their order. In this grade pupils should be taught how to tell [illegible] by the [illegible] at least so far as to include the hour [illegible] er-ho[illegible]

FOURTH GRADE.

NUMERATION AND NOTATION.—The three places of the *units' period* should be taught first, and so thoroughly that the pupils can name each place in the period at sight, in order and out of order. Require the pupils to tell, in order and out of order, which is the units' place—*the first;* the tens' place—*the second;* the hundreds' place—*the third.* Dictate numbers for the pupils to write, as follows: 5 units and 2 tens; 2 units and 6 tens; 9 units and 1 ten; 3 tens and 6 units; 7 tens; 1 unit, 8 tens and 3 hundreds; 4 hundreds, 6 tens and 5 units; 2 hundreds and 6 tens; 8 hundreds and 1 unit; etc.

On commencing instruction on the *thousands' period* teach the names of the three places—thousands (or units of thousands), tens of thousands, hundreds of thousands; also, the corresponding numbers of the places—*fourth, fifth* and *sixth.* Follow the same plan of instruction as for the *first period;* then use numbers combining both periods. Also, dictate numbers as follows: write 419 thousand, 312; 301 thousand, 806; 9 thousand and 1; etc.

ADDING.—In the Fifth Grade pupils added single columns on the blackboard and copied and added similar columns on their slates. Begin in this grade with short columns of figures, dictated, to be added on the slates: gradually the columns should be made longer and, toward the last, they should consist principally of 6's, 7's, 8's and 9's.

Teachers are again reminded that *counting* is not *adding:* they are also referred to the important suggestions given in the preceding grades.

A few figures arranged in a circle on the blackboard

will furnish a simple means of exercising the pupils in adding, each pupil in turn adding a single figure to the amount obtained by the preceding pupil; or, the teacher may point successively to several figures and then require the pupils, at a given signal, to write the sum on their slates.

SUBTRACTING.—Teach the *subtracting* by means of the facts learned in the *adding*. Ask questions in the manner indicated for the Fifth Grade: 4 and how many are 11? 6 and how many are 14? 2 and how many are 16?

Last of all, resort to the "subtracting" form—4 from 11 are how many? In teaching give due attention to the *unit figure*.

MULTIPLYING.—See suggestions for the Fifth Grade.

PRACTICAL QUESTIONS.—Exercises should be given for *adding* concrete numbers silently: the teacher should dictate the numbers with sufficient slowness to permit the pupils *to add*, but with sufficient rapidity *to prevent counting*, and they should have the answers written simultaneously on the slates. The following are examples: 9 cents, 5 cents, 8 cents, 4 cents and 6 cents? *Ans.*—32 cents. 12 pencils, 4 pencils, 8 pencils, 6 pencils and 10 pencils? *Ans.*—40 pencils. 3 dollars, 7 dollars, 9 dollars, 6 dollars and 4 dollars? *Ans.*—29 dollars.

For exercises without slates give such questions as the following: 8 cents and 6 cents? 6 apples and 13 apples? 27 pencils and 6 pencils? 15 dollars, 3 dollars, 8 dollars and 6 dollars?

For *subtracting* the teacher may give questions the answers for which may be given orally by individuals or, on the slates, by the class. The following are suggestive: If you have 8 cents and spend 3 cents; how many cents will you have left? *Ans.*—5. You have 11 marbles and

lose 5 of them; how many will you have left? *Ans.*—6. You have 6 cakes: if you eat 3 cakes, how many will you have left? *Ans.*—3. If you make 13 marks on your slate and then rub out 5 of them, what will remain on your slate? *Ans.*—8 marks.

Exercises similar to the following may be employed with *much benefit to the pupils.* The teacher says, "Mary had 12 cents and lost 5." The pupil should say, "Mary had 7 cents left." The teacher says, "John has 12 cents and Jane has 6." One pupil may say, "Both together have 18 cents." Another pupil may say, "John has 6 cents more than Jane." And still another may say, "Jane has 6 cents less than John." By such exercises as the above the pupil is trained to *think* and to *talk.* The teacher should see that the pupils answer with a *sentence.* In the first illustration the answer, "7 cents left," should never be accepted.

Roman Numbers.—Teach the numbers through L. In this grade it will not be necessary to teach the "key" to Roman Numbers.

THIRD GRADE.

Addition and Subtraction.—The new step in written addition for this grade consists in "carrying." At first have the pupils separate the sum of the units' column into *units* and *tens*, the units to be placed under the units' column and the tens to be added in with their proper column: let them deal with the tens' column in a similar manner. While teaching the process of "carrying," give examples with short columns: as soon as the pupils understand the *process*, give examples which will test their ability to add with accuracy and rapidity.

N. B.—Special attention should be given to practical examples with concrete numbers. *Do not tell the pupil what to do. Avoid asking unnecessary questions:* make the statement, then *let some pupil ask the corresponding question.*

Read carefully the suggestions made in the preceding grades.

The usual names of the answers in addition—*sum, amount*—should be taught in this grade; also, the sign of addition (+).

Practical Questions.—The following examples will suggest additional forms for answers in this grade:

If a coat cost $15, and a hat $5, how much will both cost? *Ans.*—Both will cost $20, which is the sum of $15 and $5.

Henry had 8 marbles and bought 4 more; how many marbles had he then? *Ans.*—Henry then had 12 marbles, which is the sum of 8 marbles and 4 marbles.

A boy had 9 apples and gave away 5 of them; how many apples had he left? *Ans.*—He had 4 apples left; because 5 apples taken from 9 apples will leave 4 apples.

The full form of the answer should be required only occasionally; *in nearly all cases very brief answers should be given;* as (in the examples above), $20, 12, 4.

Multiplication Table.—Review the table of twos in the manner shown in the preceding grades. Counting by threes the successive results are 3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36. The first two results became known to the pupils in the preceding grade; hence, the first new matter for this grade begins with *three* threes.

Arranging in columns we have the table of *threes* and its corresponding table of "3 times":

3 threes are 9	
4 threes are 12	3 fours are 12
5 threes are 15	3 fives are 15
6 threes are 18	3 sixes are 18
7 threes are 21	3 sevens are 21, etc.

Review this table as shown for the table of twos.

In like manner teach and review the table for *fours*, *fives* and *sixes*.

Roman Numbers.—In this grade the following key to Roman Numbers should be explained to the pupils, and numerous applications of it should be made. By this means the necessity for memorizing the several combinations may be avoided.

First.—When letters representing equal values stand side by side, and, also, when a letter representing a smaller number stands on the right-hand side of one representing a larger number, the several values are to be added; as, II, *two;* XX, *twenty;* XXX, *thirty;* VI, *six;* XV, *fifteen;* LX, *sixty;* XXV, *twenty-five;* CXI, *one hundred and eleven.*

Second.—When a letter representing a smaller number stands at the left hand of one representing a larger number, the value of the left-hand letter is to be taken from the value of the right-hand letter. Examples: The value of I is taken from the value of V in the combination of IV, to represent *four.* XL represents *forty*, because *ten*, the value of X, taken from *fifty*, the value of L, leaves *forty.* XC stands for *ninety*, because *ten* taken from *one hundred* leaves *ninety.*

Third.—Whenever I or X is placed between two letters of greater value, its value is to be taken from that letter which follows.

NOTE.—Neither V, L, nor D is to be placed by itself, nor is it to be placed before a letter representing greater value.

Brief reviews of the application of this key in determining the value of given combinations, with the addition of M in Roman numbers for the other grades will secure all the knowledge of this subject that is of practical value.

SECOND GRADE.

ADDITION AND SUBTRACTION.—Continue the written exercises in addition as in the Third Grade; continue, also, the exercises for training the pupils to add without counting. Due use is to be made of practical examples with concrete numbers.

The processes of subtraction are to be taught in this grade. These may be arranged in steps and presented in the following order:

First Step.—Give short examples in which each figure in the subtrahend represents a smaller number than the figure above it in the minuend.

Second Step.—Give examples in which it is necessary to transfer from a column of a higher denomination.

Third Step.—Give examples with *naughts* in the *minuend* which will make it necessary to transfer from the second or third place to the left.

Illustrate the second step by cents, dimes and dollars; show by changing the dime to cents, how to transfer from the tens to units; also, by changing the dollar to dimes, how to transfer from the hundreds to tens. This process may be illustrated on the blackboard with examples similar to the following:

(1.)

4	10	10
$5	1*d.*	2*c.*
$2	5*d.*	6*c.*
$2	5*d.*	6*c.*

(2.)

4	10	10
5*h.*	1*t.*	2
2*h.*	5*t.*	6*u.*
2	5	6

(3.)

4	10	10
5	1	2
2	5	6
2	5	6

(4.)

.	.	
5	1	2
2	5	6
2	5	6

It will be observed that in the above examples the first (1) represents dollars, dimes and cents; the second (2), third (3) and fourth (4) represent hundreds, tens and units. In the third example the transferring of *one* of a higher denomination is represented by cancelling the figure and writing the remainder above it; in the fourth example the fact that *one* has been taken away is indicated by a *dot* over the figure from which it was taken.

The two following examples illustrate the process of subtracting when a naught occurs in the minuend:

5	10	9 10	10
6	1	0	4
5	3	4	8
	7	5	6

.	.	.	
6	1	0	4
5	3	4	8
	7	5	6

The above and similar illustrations should be repeated until the process is understood, after which the actual can-

cellation should be omitted and *dots* used. The use of dots over the minuend may be continued for a short time.

The old method of *adding one to the next figure of the subtrahend* may be taught, provided the teacher makes clear to the pupils the reason underlying the process.

The terms employed in subtraction—*minuend, subtrahend* and *remainder* (or *difference*)—should be taught. These be used in connection with the examples for this grade also, the sign of subtraction (—) and that of multiplication (×).

MULTIPLICATION.—The instructions may be given in three steps, as follows:

First Step.—Give examples in which no single product will exceed *nine*.

Second Step.—Give examples in which some of the single products will be greater than nine, making it necessary to "carry" to the product in the next column. At first use for multipliers the numbers less than *six*: after the pupils have become familiar with the *method*, increase the value of the multiplier.

Third Step.—Give examples in which the multiplicands contain one or more *naughts*.

When the pupils have used 10 as a multiplier, show them the *short way* to multiply by that number. A well-taught class ought to master all of the steps in multiplication in four weeks.

The terms used in multiplication—*multiplicand, multiplier* and *product*—should be taught before the pupils are promoted to the next grade.

Simple practical examples are to be given in addition, subtraction and multiplication.

PRACTICAL QUESTIONS.—Read carefully the suggestions on practical questions in the preceding grades.

The following examples will suggest appropriate forms for answering questions in this grade.

A man paid $12 for a barrel of flour, $6 for a ton of coal and $4 for a load of wood; how much did he pay for all? *Ans.*—He paid for all $22, which is the sum of $12, $6 and $4.

A farmer paid $50 for a cow and sold her for $37; how much did he lose? *Ans.*—He lost $13, which is the difference between $37 and $50.

What will 6 oranges cost at 4 cents each? *Ans.*—24 cents: if one orange costs 4 cents, 6 oranges will cost 6 times 4 cents, which are 24 cents.

The rapid combination of numbers, mentally, should be made a special exercise at least once a week. In the drills for this purpose the teacher may dictate as follows: 9+6+7+8+6+5+9+8; write the answer. 30−7−5−9; write the answer. 23+4−5+3+7−8; answer. The pupils will make the combinations silently and will write on their slates the answer only. The teacher may then ascertain how many are correct.

Multiplication Table.—Teach as suggested for the preceding grades.

The review should include questions similar to the following: Which is the greater, 3 nines or 4 sevens? 4 nines or 12 threes? 7 sevens or 12 fours? 8 eights or 7 nines? 10 fours or 5 eights? 5 fours or 10 twos? 5 fives or 8 threes?

Roman Numbers.—Continue instruction as in Third Grade.

FIFTH GRADE.

—See suggestions
is separated by
between the figures
Made too Wide.
Do not

Second Step.—Use multipliers similar to the following: **120,** 348, 5,630; multiplicands not to contain more than **four** figures.

Third Step.—Use multipliers similar to the following: **406,** 9,030, 8,007; multiplicands not to contain more than **six** figures.

Pupils should be carefully trained to write *the first figure of each partial product under the figure used as a multiplier.*

Review each step with practical examples embracing transactions that come within the observation of the pupils.

DIVISION.—The idea of separating numbers into several equal parts having been illustrated sufficiently with objects, etc., in the lower grades as an introductory step to division, the teacher should now proceed to show the different ways by which division may be represented with figures.

First Step.—Place upon the blackboard the following forms of division:

$$2)8 \qquad 8 \div 2 = \qquad \frac{8}{2} =$$

Tell the pupils that each of these forms of writing numbers means that they are to find *how many twos there are in eight;* or, that *the number eight is to be divided into two equal parts.* Let the pupils tell how many each part will contain; then write the number in connection with each example, as follows:

$$2)8 \qquad \begin{array}{r} 4 \\ \hline 2)8 \\ 8 \\ \hline \end{array} \qquad 2)8(4 \qquad 8 \div 2 = 4 \qquad \frac{8}{2} = 4$$

$$\underline{4}$$

It will be seen that in the first form there may be three ways of placing the answer.

After repeating these four modes of representing division, with other numbers, require the pupils to copy each form on the slate, and to perform the division.

N. B.—Do not allow the pupils to say "divide two into eight." Eight is divided *by* two.

Second Step.—Use examples first in which each figure of the dividend will contain the divisor without a remainder, thus:

2)4286	3)39630	4)8408
2143	13210	2102

Third Step.—Give examples in which remainders occur during the partial divisions: *if thought advisable*, let them be worked first by the long division method, as follows:

244	119	203	174
4)976	8)952	6)1218	3)523
8	8	12	3
17	15	18	22
16	8	18	21
16	72		13
16	72		12
			1

Note that in short division *the answer is placed below* the dividend: in long division *the work is placed below;* hence, *the answer is placed above.*

If the teacher resort to the long division method, let her have the same examples worked immediately after by the short division method. In this way she will impress upon the pupils the fact that the second method is the better because it saves time. It should be noted by the teacher that *short division*, not long division, is the subject of instruction for this grade; hence, the long division form is to be made use of only when it is thought to be the quickest way of teaching short division, and it is to be discarded at the earliest moment possible.

Aim first *to make the pupils understand the process of the rule;* then *train them to be accurate;* and finally, *drill in rapidity.* Never attempt to gain rapidity to the neglect of accuracy.

As soon as the pupils understand the manner of doing the work in any rule, give practical examples: do not wait for either accuracy or rapidity before giving such questions.

The ability of pupils to work practical examples in the four simple rules is the real test of their knowledge of this subject.

Practical Questions.—The forms for answering questions in addition, subtraction and multiplication, in this grade, may be the same as in the Second Grade. Questions may also be introduced which may require both addition and subtraction for their solution, as:

Henry had 18 cents; he gave 2 cents for pencils, and 6 cents for a sponge; how many cents had he left? *Ans.* —10. Henry spent the sum of 2 cents and 6 cents, which is 8 cents. He then had left the difference between 8 cents and 18 cents, which is 10 cents.

The same example might be performed by the subtraction of 2 cents, and then of 6 cents.

DIVISION.—The following examples will illustrate forms of solution appropriate for mental questions in division:

How many tops at 3 cents each can be bought for 12 cents? *Ans.*—4: as many tops as 3 cents is contained times in 12 cents. *Or*—12 cents is 4 times 3 cents; therefore 4 tops can be bought.

If 2 apples cost 4 cents, what will 1 apple cost? *Ans.*—2 cents: 1 apple will cost one-half of 4 cents.

ORAL DRILLS for rapid combinations of numbers may embrace combinations with multiplication, addition, division and subtraction. See also suggestions for oral drills in the previous grades.

MULTIPLICATION TABLE, reviewed as a *Division Table.*—In making this review the teacher may ask: How many fours in 20? How many fives in 30? How many twelves in 48? etc. The form of the questions may be changed to, In 40, how many eights? The teacher can easily change the form of this review so as to make it both practical and interesting.

TABLES OF MEASURE AND WEIGHT.

SECOND GRADE.

UNITED STATES MONEY.

10 cents make 1 dime.
10 dimes make 1 dollar.
100 cents make 1 dollar.

25 cents make a quarter of a dollar.
50 cents make a half of a dollar.
75 cents three-quarters of a dollar.

Liquid Measure.	Dry Measure.
4 gills make 1 pint.	2 pints make 1 quart.
2 pints make 1 quart.	8 quarts make 1 peck.
4 quarts make 1 gallon.	4 pecks make 1 bushel.
	2 quarts make 1 small measure.

Time Measure.

60 seconds make 1 minute.	7 days make 1 week.
60 minutes make 1 hour.	365 days make 1 year (common).
24 hours make 1 day.	100 years make 1 century.

Teach, also, the *days*, the *months*, and the *seasons* with their months. Teach the number of days in each month: February, 28 or 29: those with 30 days, easily fixed in the memory by means of the familiar couplet,

"Thirty days hath September,
April, June, and November;"

all the others, 31.

The tables of weights and measures should be introduced by talks with the pupils about their experience in seeing them used, and by other familiar illustrations. The table of *United States Money* may be illustrated by the use of cents, dimes and dollars; that of *Time* by the use of a clock dial, and by attention to days, weeks, months and years; that of *Liquid Measure* by what the children know about buying milk, molasses and kerosene by the pint, quart and gallon; that of *Dry Measure* by their pur-

chases of fruits, nuts and vegetables by the quart, s measure and peck.

After talking with the pupils about a given table, w it on the blackboard and let the pupils repeat it; l let them copy it on slates, both in the order of the and in a different order. Continue the repetition copying until the table is thoroughly learned.

In reviewing these tables, the teacher may questio pupil somewhat as follows: How many hours mak day? How many days make a year? How many d make a week? How many minutes make an hour? H many months are in a year? Which is the shortest mea ure of time? Which is the longest measure of time?

How many quarts make a gallon? How many quar in seven gallons? How many quarts make a peck? H many pints in five quarts? How many quarts in thre pecks? Which is the more, one bushel or three pecks?

Simple questions in oral arithmetic may be given, wit a view to a practical application of the foregoing tables.

FIRST GRADE.

Avoirdupois.

16 ounces make 1 pound.
2,000 pounds make 1 ton.
8 ounces make 1 half-pound.
4 ounces make 1 quarter of a pound.

Long Measure.

12 inches make 1 foot.
3 feet make 1 yard.
36 inches make 1 yard.

Miscellaneous Table.

12 things make 1 dozen.
20 things make 1 score.
24 sheets make 1 quire of paper.

After these tables have been thoroughly learned, the teacher should conduct brief reviews of the tables of both the First and Second Grades, by questions somewhat like the following:

How many inches in three-quarters of a yard? How many pounds in a half-ton? How many pecks in twelve bushels? How many quarts in nine gallons? How many days in a year? How many months in half a year? Which is the longer, six feet or two yards? How many buttons in five dozen? How many sheets of paper in a quire? How many in half a quire?

Simple questions in mental arithmetic may be given, with a view to a practical application of the foregoing tables.

WRITING.

General Suggestions for all Grades.

Attention should be given to the position of the slate or paper, to the manner of holding the pencil, and to the proper positions for writing.

Note.—The direction of the light is a matter of supreme importance in arranging seats for the pupils.

Slates or paper used for teaching writing should be ruled, with head-lines, so that the writing shall be at least as large as that in the first copy-book to be used.

A guide slant-line at the beginning of each line will prove very helpful to the pupil and thus will lighten the labor of the teacher.

To allow proper freedom for the movement of the hand, the work should be written at a sufficient distance from the left-hand margin.

In ordinary print the letters of a word are not con-

nected: in a written word the letters should be joined together so that the word will appear as a connected whole not as a collection of separate letters. Hence it is most important that the child's first attempt at writing should include such an essential feature as *continuity*.

To carry out this idea in a natural and easy manner, the alphabet should be divided into groups of letters according to the ease or difficulty of writing them in words.

In the first, or simplest group, should be found certain single-space letters which can be easily written together so as to form such words as *in, me, men, sun, see,* etc. The following grouping is suggested:

1st.—*i, n, m, e, u, v, w, r, s.*

2d.—*t, l, h.*

3d.—*o, c, a, b, y, j.*

4th—*d, p, z.*

5th.—*f, g, q, k, x.*

The pen being more difficult to use than the pencil, special pains should be taken by the teacher to see that the pupils hold the pen correctly and have the hand and the copy-book in their proper positions.

The order of progression in teaching to write with the pen should be substantially the same as that employed in teaching to write with the pencil. Let the pupils begin to write simple words (without capitals) the forms of whose letters they have previously learned.

All the pupils should write the same copy at the same

time, thus enabling the teacher to instruct them simultaneously on the same points. In some cases it has been found desirable to have all write the same *word* at the same time. It is not necessary that the pupils should fill all the lines under each copy of the writing-book. Whenever they have made sufficient progress to be able to proceed with the next copy in order, let them go on with it.

In addition to the usual exercises in the writing-book occasional lessons may be given in copying, in ink, sentences from the blackboard. These and the First Grade dictation exercises, corrected, may be written on the usual lines of the writing-book.

Written spelling should be utilized for exercises in writing, but great care should be taken that the writing be not injured in quality by being too hurried.

Pupils will be greatly encouraged, if, each day, writing that shows greatest improvement be selected and placed where it may be examined by the Principal and by visitors.

The Principal should take special pains to notice each exercise thus selected.

Special Suggestions.

Sixth Grade.—In this Grade children should write short words formed from letters in the first group: the capital letters should not be taught yet.

Fifth Grade.—The remaining small letters also should now be used in writing words: such words as *rough*, *full*, etc., should be avoided on account of their obvious difficulty.

Occasional exercises should be given in writing words without the assistance of head-lines.

Each pupil may be taught to copy his own name with the proper capitals.

Fourth Grade.—More attention should be given to words containing long letters: such words as *ought*, *flight*, etc., should be avoided. No sentence to be copied should contain too many difficulties: when a teacher fails to apply this idea in selecting copies, the pupils' work invariably presents a poor appearance. Only the simplest capitals should be used in the sentences. Attend to the *periods* and the *question marks*.

Each pupil should be taught to write his name without copy.

Third Grade.—Close attention should be paid to the use of *capitals*, *periods* and *question marks*.

Second Grade.—Same as Third Grade.

First Grade.—Teach the uses of the *hyphen*: pupils should be taught that a syllable should never be divided.

GEOGRAPHY.

FIRST GRADE.

Teach the pupils points of the compass—East and West, by means of observation of the directions in which the sun rises and sets; and North and South, from observing the direction of the sun at noon, or by the use of the needle.

Then proceed, first, to teach them the location, direction and comparative distance of streets, churches, parks, railway stations, ferries, etc., familiar to the pupils; as a help to the determination of distances the teacher should use the familiar local measurement—twenty blocks to a mile.

In giving the pupils the first notions of a map, direct them to draw the outline of the *block* on which the school building is situated: the top of the slate or paper should be laid toward the *North* and the lines drawn be made to take the directions of the boundaries of the block.

Direct the pupils to indicate on this map the location of the school building.

Secondly, to teach the location, direction and comparative distance of places in the vicinity of the city, concerning which places the pupils have some knowledge.

Thirdly, by means of reminiscences of excursions and vacation trips to extend the exercises in location, direction and comparative distance of places, and, when practicable, to point out on maps the places mentioned.

Fourthly, to teach the pupils to represent with clay, on a moulding board, the following geographical elements of the land surface and the water surface:

Island,	*Lake,*
Isthmus,	*Strait,*
Peninsula,	*Gulf or Bay,*
Mountain chain,	*River,*

and then to draw, as a map, these representations. Use the terms to designate these forms of land and water, *but do not teach definitions.*

NOTE.—The modeling and the drawing of the maps form a part of the regular exercises in "*Form and Drawing.*"

Fifthly, to teach the *shape of the Earth* by means of *marbles, balls, oranges* and *terrestrial globe.* Teach direction on the globe—North, South, East, West. Teach the pupils to distinguish the land surfaces from the water surfaces as they are represented on the globe. Teach the

location and the name of each of the six great divisions of *land surface—Asia, Africa, Europe, North America, South America* and *Australia;* also, the location and the name of each of the five great divisions of the *water or ocean, surface—Pacific, Atlantic, Indian, Arctic* and *Antarctic.* Also, teach the pupils to find on the globe and on outline maps, *but without giving names,* examples of islands, peninsulas, lakes, rivers, etc., as previously taught by means of the clay and other maps made by the pupils.

Sixthly, to associate the divisions of land and water with their distinctive inhabitants and productions; as, Africa, the home of the Negro, the Lion and the Zebra —North America, the country where we live, etc.

SEWING.

General Suggestions.

Use at first red thread, which will show the stitches on the muslin.

If necessary let the child rule, with a pencil, a straight line on the muslin before basting work.

THIRD GRADE.

The use of the *thimble* should be taught; what finger to put it on, and why used.

Then teach the child to break off a piece of thread the length of her arm, and to make a knot at the end.

Practice the *threading of the needle* and the drawing of the needle and thread, through pieces of muslin, with the hands in proper position for sewing.

With paper teach the use of *scissors.*

Two pieces of muslin should be given to each pupil: the teacher should hold up two similar pieces, fold over the raw edges before the class and baste the edges together.

Then let each child do the same and take special pains to fold over the edges evenly and to make regular *basting stitches* in straight lines.

Illustrate these lines on a blackboard, and teach that a row of stitches can be made in as straight a line as can be made by a pencil on a slate.

When basting is understood, teach the child to *overhand*, starting from the right hand and sewing toward the left. Especial attention should be given to the starting and finishing off of the work. *Even stitches* should be the *first* consideration—finally, stitches are to be made *small* as well as even.

SECOND GRADE.

With square pieces of paper teach the child to turn down *hems*, both wide and narrow. When facility is gained, practice the same upon pieces of muslin; next let the child baste the hem, as edges were fastened in the preceding grade. When the hem is ready, the child should be taught that the stitches in hemming must be slanting; illustrate such on the blackboard.

Let the child first learn to put the needle through the turned-down edge only, leaving the knot or a little end of the thread to be tucked under the hem and sewed in by the first stitches. When ready for these, let the needle be nearly on a line with the hem, with the point toward the left hand.

Let the stitches be even, becoming smaller with practice.

Care should be taken that the ends of a hem are neatly over-handed.

When hemming is understood, *running* or *seam sewing* should be taken up. The rule for fine running is—take up two threads and skip two; but such careful work can only be obtained after considerable practice.

The child must be trained to make stitches of uniform size and so that they shall form straight lines.

As the edges of the seam are rough, the child must be taught to *overcast* them after they are trimmed evenly.

Overcasting stitches should be easy, slanting, even, and not too close or too deep.

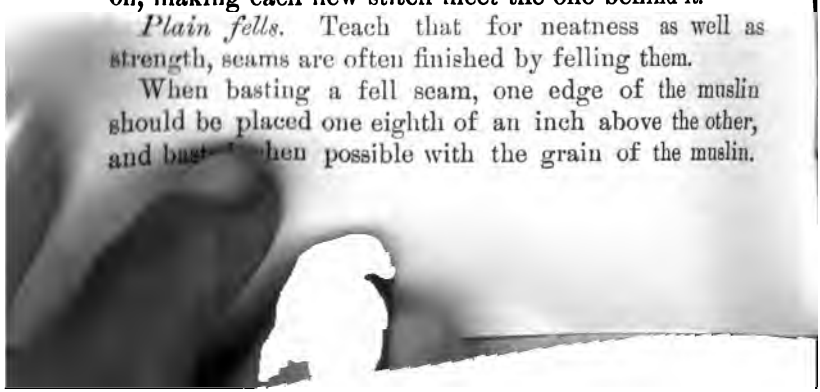
FIRST GRADE.

Review running stitches; the child must be shown that such stitches have not sufficient strength for all purposes, and that, where greater strength is needed, other kinds of stitches must be used.

Seams of waists and sleeves and such others as require strength must be stitched or back-stitched. In stitching, the stitches meet—in back-stitching there is a space between. Rule for stitching: after the thread is drawn through to the right side, put the point of the needle *back* two threads and pass it under two *before*, and so on, making each new stitch meet the one behind it.

Plain fells. Teach that for neatness as well as strength, seams are often finished by felling them.

When basting a fell seam, one edge of the muslin should be placed one eighth of an inch above the other, and basted when possible with the grain of the muslin.



The seam is sewed with one back-stitch alternating with two running stitches. The upper edge is then turned over and hemmed down neatly, without being basted, the edge being turned under with the needle, an inch at a time, care being taken to make the seam flat on the right side.

When a *straight* fell has been learned, practise a child on *bias* fells.

TEACHERS' MANUAL.

MANUAL-TRAINING COURSE OF STUDY

PRESCRIBED FOR GRAMMAR SCHOOLS.

EIGHTH GRADE.

LANGUAGE LESSONS.—*Reading* of the grade of the Third Reader: *oral lessons* on the qualities and uses of familiar objects, such as articles of clothing, food, material for building, and so forth: *compositions: spelling, meaning and use of words*, chiefly from the lessons of the reading book and from the oral lessons of the grade; also selected miscellaneous words in general use, at least 100 in number, to be taught chiefly by writing them separately, and in short sentences from dictation.

GEOGRAPHY.—The World, from globes and outline maps.

ARITHMETIC.—Through the simple rules and Federal Money, with practical examples: selected tables of weights and measures, with simple practical applications.

PENMANSHIP.—Words with capitals.

FORM AND DRAWING.—*Drawing*—(Free-hand)-circles; arrangements of simple and compound simple historic borders; symmetrical arrangement date leaves; simple objects, from nature; map.

chanical)—Use of instruments; applications of si- practical problems of geometry; patterns formed fro- tersecting parallel lines; surface patterns, hexagonal octagonal; parallel lines as used for shading. *Cutting modeling*—from drawn work.

SEWING.—Review hems and bias fells: French sea- gathering.

SEVENTH GRADE.

LANGUAGE LESSONS.—*Reading* of the grade of a Thi- Reader (a different book from that used in the Eigh- Grade): *oral lessons* on animals: *compositions: spellin- meaning and use of words*, as before—at least 100 addi- tional words, and review of those previously taught.

GEOGRAPHY.—Western Hemisphere in outline, together with review of preceding grade—without text-book.

ARITHMETIC.—Through subtraction of common fractions with practical examples: selected tables of weights and measures, as before.

PENMANSHIP.—Words and phrases.

FORM AND DRAWING.—*Drawing*—(Free-hand)—Circles; borders, two different units to be used in each; symmetrical arrangement of hastate leaves; simple objects from nature; maps. (Mechanical)—Applications of simple practical problems of geometry; straight lines, "dotted," etc.; door with panels, and window with panes, from measurements made in class; running patterns from circles and arcs; trefoil in triangle. *Cutting and modeling*—from drawn work.

SEWING.—Button-holes; sewing on buttons; patching.

SIXTH GRADE.

LANGUAGE LESSONS.—*Reading* of the grade of an easy Fourth Reader: *oral lessons* on plants: *compositions: spelling, meaning and use of words*, as before—at least 200 additional words, and review of all previously taught; easy exercises in suffixes.

GEOGRAPHY.—Eastern Hemisphere in outline, together with review of preceding grade—without text-book.

ARITHMETIC.—Common fractions completed, with practical examples: selected tables of weights and measures, as before.

PENMANSHIP.—Phrases and sentences.

FORM AND DRAWING.—*Drawing*—(Free-hand)—Ellipses; ovals; vases; original designs with leaf and flower: simple objects, from nature; maps. (Mechanical)—Applications of simple practical problems of geometry; table, etc., from measurements made in the class; arches, by arcs of circles; quatrefoil in circle; designs (ornate), circle and contents; window, pointed arch. *Cutting and modeling*—from drawn work.

SEWING.—Herring-bone stitch and flannel patching; darning stockings; darning tears and cuts.

FIFTH GRADE.

LANGUAGE LESSONS.—*Reading* of the grade of a Fourth Reader: *oral lessons* on the human body: *comp spelling, meaning and use of words*, as before—a additional words, and review of all previously t ercises in prefixes and suffixes.

HISTORY OF THE UNITED STATES.—A brief general outline—without text-book.

GEOGRAPHY.—Western Hemisphere in detail, with special attention to the United States, together with review of preceding grade.

ARITHMETIC.—Decimals, with practical examples in common and decimal fractions: reduction, ascending and descending, of integral denominate numbers.

PENMANSHIP.—Phrases and sentences.

FORM AND DRAWING.—*Drawing*—(Free-hand)—Regular pentagon; Greek vase, with perspective effect; Egyptian and Greek borders; flowers and trilobate leaves in original designs; maps; elevations, plans and other views of cubes, prisms, cylinders and cones. (Mechanical)—Simple graphic solutions of selected geometrical theorems; elevations, etc., already drawn free-hand; drawing required for shop-work. *Modeling*—Relief maps. *Shop-work*—Use of tools—knife and jack-plane; making joints—butt, butt-mitre, lap, etc.

SEWING.—Review all previous work; tucking, gussets.

FOURTH GRADE.

LANGUAGE LESSONS.—*Reading* of the grade of a Fourth Reader (a different book from that of the Fifth and the Sixth Grade) and in Supplementary Reader upon the subjects of the oral lessons of this or previous grades: *oral lessons* on common minerals and metals: *compositions: spelling, meaning and use of words*, as before—at least 100 additional words, and review of all previously taught; exercises in prefixes and suffixes, continued: *English grammar* (without text-book)—the construction of sentences,

th a view to develop a knowledge of the parts of eech, and to illustrate the terms *subject, predicate and ject.*

HISTORY OF THE UNITED STATES.—Outline with greater etail—without text-book.

GEOGRAPHY.—Eastern Hemisphere in detail, with spe-ial attention to Europe, together with review of preceding grade.

ARITHMETIC.—Denominate numbers completed, with practical examples.

PENMANSHIP.—Practice in large and small writing.

FORM AND DRAWING.—*Drawing*—(Free-hand)—The spiral; flowers and lobed leaves in original designs; mediæval and moresque ornaments; ornamented vases; maps; working-sketches of tools and of joints; sections of solids. (Mechanical)—Simple graphic solutions of selected geometrical theorems, continued; working-drawings for shop-work. *Modeling*—Relief maps. *Shop-work*—Use of tools—add crosscut-saw, hammer and nails, and chisel; making joints, etc.

SEWING.—Measuring, cutting paper patterns, and fitting.

THIRD GRADE.

LANGUAGE LESSONS.—*Reading* in Supplementary Reader upon subjects of the oral lessons in this or in previous grades: *oral lessons* on the simple facts of natural philosophy: *compositions: spelling, meaning and use of words*, as before; exercises in the formation of derivative words: *English grammar* (without text-book), continued.

HISTORY OF THE UNITED STATES.—Through the Revolutionary War—class-reading in text-book and in hi

torical Supplementary Reader. No home lessons to be given.

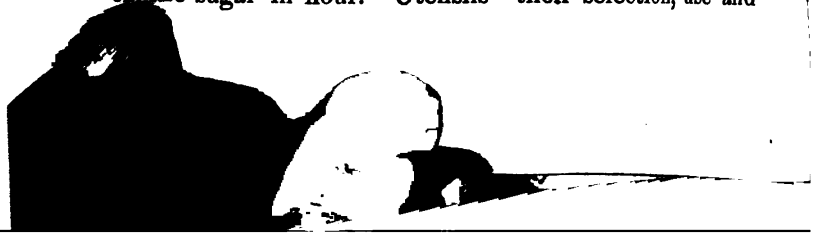
GEOGRAPHY.—General review, with special attention to the United States and Europe. Supplementary reading in geography.

ARITHMETIC.—Percentage, its applications to ordinary business transactions which do not involve the consideration of time.

PENMANSHIP.—Practice in different styles; letter-writing.

FORM AND DRAWING.—*Drawing*—(Free-hand)—Historic vase, decorated; original pottery form, decorated; historic ornaments; original surface covering, not less than two different units to be used; original circular border; maps; working-sketches for shop-work. (Mechanical)—Simple graphic solutions of selected geometrical theorems, continued; working-drawings for shop-work. *Modeling*—Relief maps; simple forms for carving. *Shop-work*—Use of tools—add gouge, rip-saw, center-bit and hand-screws; cutting mouldings, etc.; making joints—lap, scarf and mitre.

COOKING.—Materials of the human body: tissues—waste of; repair of. Digestibility—cooking solid materials to prepare them for digestion. Nutritiveness—nutritive values of foods: palatability. Food elements—groups of—mineral: starch and sugar: fats; albuminoids. Related facts—physical and chemical: kinds of fuel: effects of heat on water—boiling points: temperatures of flames: physical effects of heat on albumen; on starch; on gluten; etc.: proper temperatures for various purposes: chemical effects of overheating: principle and action of yeast powders; of leaven; of yeast: important function of the sugar in flour. Utensils—their selection, use and



eservation. Purchasing food—discrimination as to holesome and unwholesome: choice of parts. The germ theory"—applied to foods.

Practical exercises in cooking involving simple applications of facts and principles taught.

SECOND GRADE.

LANGUAGE LESSONS.—*Reading*—supplementary reading as before: *oral lessons* on the simple facts relating to air, water, light, heat and sound: *compositions: spelling, meaning and use of words*, as before; exercises in the formation of derivative words, continued: *English grammar*—the construction of compound and complex sentences, with the view of teaching propriety of expression.

HISTORY OF THE UNITED STATES.—Completed, with very brief outline of federal, state and municipal government: instruction as in Third Grade.

ARITHMETIC.—Interest and discount; simple proportion.

PENMANSHIP.—Paragraphs; business forms, such as bills, receipts, drafts, etc.; letter-writing continued.

FORM AND DRAWING.—*Drawing*—(Free-hand)—Original designs for industrial purposes: from the model—cube, square prism, square pyramid, cylinder and cone; working-sketches for shop-work. (Mechanical)—Working-drawings for shop-work. *Modeling*—Simple forms for carving. *Shop-work*—Joints—dovetail, mortise.

COOKING.—As in Third Grade.

FIRST GRADE.

LANGUAGE LESSONS.—*Reading*, as before, together with poetry and fiction: *compositions: spelling, meaning a*

...ORAL TRAINING ...

...

...

. Opening exercises, 15 minutes; noon intermission, minutes.

Opening exercises to commence punctually at 9 o'clock M., and dismissal at 3 o'clock P.M.

No class exercise shall take place before 9 o'clock A.M., after 3 o'clock P.M.

3. *Reading.*—In the reading lessons of each grade the pupils shall be required to state in their own language the subject matter of the lesson. Supplementary readers shall not be taken home by pupils. Prose and verse recitations by the pupils in the schools shall be selected from books upon the supply list of the Board of Education.

4. *Writing.*—Use of Pencils and Pens. The pupils not to be allowed to use short pencils; in all the grades particular attention to be given to the proper manner of holding the pen and pencil, and to the position at the desk. The exercises in each grade to be such as are required to give ease and rapidity, as well as accuracy in style. Blackboard instruction to be given in each grade. Pupils of all the grades shall have dictation exercises, at least once a week.

5. *Composition.*—Compositions shall be written once a week in all grammar classes, in presence of the teachers, upon subjects connected with the oral lessons of the grades, or upon subjects read and explained in the class room; and these compositions shall be criticised and re-written. Home work shall be limited to the First Grade.

6. *Dictation and Correction of Language.*—Exercises in writing sentences and paragraphs, from dictation, shall be given in each grade, and the pupils in all the grades shall be trained in the correction of language, and taught avoid common errors in speech.

7. *Arithmetic.*—Rapid calculation in the simple rules of arithmetic should be practiced by all the pupils from the lowest to the highest grade.

8. *Singing.*—Instruction in singing shall be given to the pupils in every grade, except the first grade of boys, at least ten minutes each day. The music used shall be such as is found in the books contained in the supply list of the Board of Education.

9. *Physical Training.*—The pupils shall be exercised daily in such a manner as to expand the lungs, develop the muscles, and impart an easy and graceful carriage to the body. Calisthenic exercises shall be employed for the attainment of these objects.

10. *Manners and Morals.*—Such instruction should be given daily to the pupils of all the grades as will foster a spirit of mutual kindness and courtesy, a feeling of respect for their elders, of obedience to parents and teachers, and a love of cleanliness, order, law and truth.

Every proper opportunity should be taken to fix in the young mind an abhorrence of every form of brutality and cruelty, and to cultivate kindness to animals.

11. *Sizes of Classes.*—No class shall contain more than sixty pupils.

12. *Time in First Grade.*—Pupils in the First Grade are required to pursue the studies of that grade for one year.

GEOGRAPHY.

General Suggestions for all Grades.

1. It is of the first importance that geography should be so taught and reviewed as not to leave in the mind of the pupil a mere collection of facts, without mutual rela-

n or dependence. On the contrary, the pupil should, ›m the first, be taught to consider the *earth* as man's ›elling-place—its *motions* as bringing him the alternation day and night, and the changes of the seasons—its *land-ırface* as the chief theater of animal and vegetable life—ıe *ocean* as the world's broad highway, and the exhaust-ess source of clouds and rains, so necessary to every form ›f life on the land-surface; its currents as modifying the ›limate of continents and islands—the great permanent *air-currents* as carrying to the land the moisture from the sea—the *mountains* as its condensers, as well as the chief source of mineral wealth—the *springs* and *rivers*, with their branches, as carrying back again the ever-circulating water of the ocean—and its *cities* and *towns*, not as black dots on a map, in colored patches which he has learned to call countries, perhaps near some crooked black streaks, which he has learned to call rivers, but as the centres of social life and development, the seats of government, and the crowded, busy hives of human industry and intelligence.

When geography is thus taught, it is one of the most interesting, important and practical of studies; but, if it is taught chiefly as a description, by unvarying formulas, of rivers, capes, peninsulas, boundaries, etc., supplemented, perhaps, by a precise, verbatim repetition of the descriptive geography, as contained in even the very best text-book, it is one of the dullest and most unprofitable.

2. Globes and maps are indispensable auxiliaries. There is no more common and pernicious error than that of *substituting the text-book for the teacher*, who thus is degraded into a mechanical *hearer of lessons*.

The pupil should be taught to have distinctly be his mind's eye the contour of the country which he

be studying, and its leading physical and political featu to this end, rough sketching of maps (from memory) be of great assistance.

In all grades there should be exercises in latitude a longitude, and in imaginary travels by land and by sea.

The teacher of geography will find in the daily ne paper a valuable auxiliary, giving information of imp tant events occurring in countries under consideration.

EIGHTH GRADE.

In teaching the hemispheres, only such topics should b included as may be taught readily by means of a blac board, a globe and an outline map of the hemisphere It is of the greatest importance that the pupil's first im pressions of geography be formed from the globe rathe than from the flat and distorted representation of the map.

The following are the principal points in the require ments of this grade. The work done should be *tested* in review, by placing the pointer in the hand of the pupil.

The *form of the earth*, its *magnitude*, the *continents* and *grand divisions*, their relative positions, their connecting isthmuses, and a few of their most important projections —the *oceans*, their positions, and principal arms and isl ands—five or six of the *mountain systems* of America, and about as many in the rest of the world; three or four well-known *volcanoes*—about a dozen of the chief *rivers* and about half as many *straits* and great *lakes*—in a very general way the location of the most important countries, such as the *United States*, *Great Britain*, *Ger y*, *China*, and of a dozen of the most im-

: *cities* of the world. With each of these cities and ies some interesting or important *fact* should be at ssociated.

general notion of *climate*, as affected by distance the equator, by elevation, and by the great ocean nts—the *motions of the earth*, and the *inclination of cis*—the *seasons*—simple map exercises in *latitude and itude*—the *zones*, their limits, and a very few of their -known and characteristic plants and animals—and, in ery general way, the location of the *chief races* of man-d. Only such definitions should be included as are ictly elementary.

SEVENTH GRADE.

North America.—*Physical*—Great bodies of water surrounding: directions from and to other continents. Surface—two great highland regions: central plain in two sections, Northern or Arctic, Southern or Mississippi Valley: slopes of the plains and resulting general courses of the rivers: great peninsulas and islands: great mountain systems two in the west, one in the east: four to six capes. Drainage—in the north by lakes and Mackenzie and Nelson rivers: in the east by the Great Lakes and St. Lawrence River: in the centre by Mississippi River and four chief branches: in the west by the Colorado, Columbia and Yukon. Coast waters. Simplest ideas of the great magnitudes of the ocean currents, cold and warm—the Gulf Stream, the Japan Current, the Arctic Current with icebergs and fogs: influence upon the winds that pass over these currents. Climate—simplest applications and examples of the effects of latitude, elevation, ocean cur-

rents, winds, etc., on climate: general climate of each division to be deduced from preceding physical geography. Rainy regions—dry regions. Zones. Populous regions.

Political—Six divisions—waters and divisions adjacent to each. *British America*—Canada, Newfoundland—capital and chief city of each: *Danish America*—Greenland—Iceland—capital or town. *United States*—capital and ten chief cities: Mexico—capital: Central America (as a whole)—most important city. *West Indies*—four great islands—one city. Some important product of each division.

South America.—*Physical*—Surrounding waters: directions to and from other continents. Surface—two great highland regions: central plain in three sections: two mountain systems: four capes. Drainage—mostly by three great rivers: neighboring cold and warm ocean currents: influence of winds from them—wet winds, dry winds: rainy regions, dry regions: significance of the many rivers. Zones. Deduced climates of each part.

Political—Spanish Republics (as a whole)—why Spanish: ten cities. *Portuguese America*, or Brazilian Empire—two cities. The *three colonies*. The three races of men—general location of each. Importance of the isthmus.

SIXTH GRADE.

The Four Continents.—*Physical*—Direction of each continent to and from other continents. The surrounding oceans.

Europe.— *Physical* — Surface — High Europe, Low Europe: two or three mountain systems: great peninsulas

and islands: great seas, gulf, etc.: four or five straits, etc. Drainage—by two or three rivers of the Great Plain: by two rivers of the northern slope of High Europe: by three rivers of the southern slope. Coast waters and their temperatures: influence on climate of these waters and the winds blowing over them: influence of the Gulf Stream; of the Mediterranean Sea; of the open Arctic plain; of the Alps, etc. (as a wall from cold winds); of winds from Africa. Applications of climate principles to various parts of Europe. Zones.

Political—Names of countries—waters and countries adjacent to each—capital and one other city of each—important products of each: people: language: Europe as chief source of our immigration.

Asia.—*Physical*—Surface—highland regions: lowland regions: three or four chief mountain systems: great peninsulas and islands: three or four capes. Drainage: three Arctic rivers: three Pacific: two Indian. Coast waters: Japan Current: the warm seas: the cold seas: influence of winds from these waters: applications of principles of climate to different regions: the rainy regions: the great desert belt and its causes. Zones.

Political—Names of countries: ten chief cities: products: people: most populous countries: why: countries governed by Europe: why (general statement).

Africa.—*Physical*—Surface—surrounding waters: their temperatures: highland and lowland regions: drainage: significance of the large riverless districts: three chief rivers: lakes: general character of climates—why—fertile regions—desert belts—zones.

Political—Mostly held or claimed by Europe—Egypt—two cities: Barbary States—two cities: Cape Colony—one city: productions of various parts. Two chief races of

men: slave trade and slavery: importance of the isthmus and canal.

AUSTRALIA AND POLYNESIA. — *Australia* — *Physical* —Highlands—lowlands—surrounding oceans—drainage—few rivers—why—desert interior—general character of its climate—zones.

Political—British colonies—three chief cities — products: three or four important groups of Pacific islands.

FIFTH GRADE.

Review Seventh Grade and add as follows:

NORTH AMERICA.—*Canada*—its provinces and districts: capitals and chief products: great Canadian waterway, transcontinental railway—their importance.

United States—Names of the several states and territories by groups—the district—relative position of adjacent states: three or four local groups of Appalachians; two groups or chains of the Rockies: two chains of the western mountains. Drainage—rivers of Atlantic slope, ten: Mississippi and Gulf system, ten: Pacific system, five: two or three transcontinental railways: three or four great trunk line systems centering at New York City. Uses of rivers.

Capital of the United States and those of the several states and territories: situation of each: also, of one or two other large cities (if any) in each state: any other fact or facts in regard to each of these cities. Seven chief lakes and about ten chief bays, sounds, etc.: in a general way, the following regions—wheat; corn; cotton; rice; sugar; coal; copper; lead; gold; silver; cattle; lumber; manufacturing: the great commercial routes, natural and artificial: the four races of men—their distribution.

Mexico—Two eastern ports, two western: volcanoes: chief products.

Central America—Names of states—capitals.

West Indies.—Four great groups of islands: four great islands: five or six chief ports: chief products.

SOUTH AMERICA.—Forest regions—cattle regions—names and locations of the *Spanish Republics*—position of each as to the great mountains, plains and plateaux—volcanoes of the Andes—capital and chief sea-port of each country—products. *Brazilian Empire*—capital—two sea-ports—products. The *three colonies.*

FOURTH GRADE.

Review Sixth Grade and add as follows:

EUROPE, ASIA, AFRICA AND AUSTRALIA.—The several countries of each—relative location—any important additional fact or facts in relation to the people or the productions of a country—one or more important cities (if any) in each—facts in regard to cities. The *Dutch East Indies*—the *Spanish. German, French* and *English* possessions in the *Pacific.*

THIRD GRADE.

GENERAL REVIEW.—(Include—in simple outline)—*State of New York*—a few leading facts in regard to principal agricultural, mineral, manufacturing and commercial interests—the chief cities along its waters and rail routes and any important facts concerning them. Also, the leading commercial relations of Canada, Mexico, Central America, the West Indies and South America with the United States. European emigration to various parts of the world.

The influence of climate, soil, minerals, etc., on the occupations and other social conditions of mankind: selected instances in the several states and countries. General ideas of the various social conditions of countries, from enlightened to savage; special instances of each.

ARITHMETIC.

General Suggestions for all Grades.

1. Exercises in arithmetic are not to be assigned for *home study* except in the First Grade. (By-laws, § 124, page 198, Manual 1887.)

2. Rapid calculation in the simple rules of arithmetic shall be practiced by all the pupils from the lowest to the highest grade. (By-laws, § 116, subdivision 7, page 193, Manual 1887.)

3. Examples requiring a large number of figures for their solution should be avoided, except so far as they may be necessary to give practical expertness.

4. Short practical examples, involving two or more of the rules, should be given frequently and in such a way as to cultivate the intelligence of the pupils.

5. In all practical examples, instead of telling the pupils to *add*, etc., give the example in such a manner as to oblige them to determine for themselves the principle and the method to be employed.

6. Explanatory or analytic statements made by the pupils should be of the simplest and most direct character consistent with clearness, and *all unnecessary repetition of formulas should be avoided.* Where this is not done, the principal effort of the pupil is to recall in due order

the set form of words, rather than to form the arithmetical combinations necessary to the solution.

7. Occasionally a pupil should be called upon to state the example before he gives the explanation of its solution.

8. Mental arithmetic should both precede and accompany written arithmetic. When the numbers involved are too great or too many to be readily retained in the memory, the slate should be employed as an assistant.

9. The exercises in mental arithmetic should, as far as possible, be of the most practical character: they should be conducted in a spirited manner and should have the character of extemporized exercises. As a rule, the examples given should be wrought silently by the class and, at a given signal, the results obtained should be written simultaneously. An analysis may then be required of one of the pupils.

10. The slates should be kept in the best condition as to cleanness; the figures should be distinctly and neatly made, and be written in lines parallel to the upper edge of the slate. A reasonable allowance should be made for imperfections in the forms of figures in exercises in which rapidity is required; yet, every effort should be made to fix in the pupils habits of care, neatness and system in all that pertains to the written exercises.

11. Every form of counting, whether by fingers, dots, marks or other devices, should be strictly prohibited, and the class should be frequently tested for this special purpose.

12. The pupils should name only the results arising from the additions of the successive figures, avoiding all that oral or mental repetition of tables which is known as the "spelling process." When the pupils show an ability to add two or more figures at a time, they should be encouraged to do so.

13. The above remark in regard to the oral or mental repetition of tables applies to *all* the fundamental rules and their applications: the processes should be reduced to the most concise form practicable.

14. Examples should be given to test the pupils' accuracy in writing numbers requiring 0's, and their knowledge of the proper methods when the multiplier or divisor ends with 0's: avoid such expressions as, "cross off the 0," etc.

15. When the divisor is less than 13, the long division process is not to be employed or allowed. Examples with such divisors as 60, 1,200, etc., should be solved by short division.

16. Teachers should remember that reviews are largely for the purpose of aiding pupils *to keep in mind* what has been previously taught. Hence, it is essential that, in advance work, examples should be so formed as to afford, in themselves, a review of preceding principles and methods. A class entering a new grade should begin immediately the work of that grade: reviewing the work of the preceding grades should accompany the advance work.

17. As far as practicable, suggestions made in one grade have not been repeated in succeeding ones: hence, each teacher will find it advisable to examine with care the suggestions made for the grades other than his own.

18. The following forms of arithmetical analysis, though here applied to the work of the Eighth Grade only, are applicable to the work of all grades.

FORMS OF ARITHMETICAL ANALYSIS.

A. (*Fundamental*)—*Multiplication.*
Question.—If 1 yard cost $3, what will 4 yards cost?
Analysis.—If 1 yard cost $3, 4 yards will cost 4 times $3, or $12.
NOTE 1.—Avoid the incorrect form "will cost 4 times 3, or 12."

NOTE 2.—*Question.*—If $1 will buy 3 yards, what will $4 buy?
Analysis.—Similar to *A*.

B. (*Derived*)—*Division.* (1.)

Question.—If 1 yard cost $3, how many yards may be bought for $12?

Analysis.—If $3 buy 1 yard, $12 will buy as many yards as $3 are contained times in $12, or 4 yards.

NOTE.—Avoid the incorrect form "as many as 3 are contained in 12."

C. (*Derived*)—*Division.* (2.)

Question.—If 4 yards cost $12, what will 1 yard cost?

Analysis.—If 4 yards cost $12, 1 yard will cost ¼ of $12, or $3.

NOTE.—Avoid the very faulty forms, "as much as 4 is contained in $12," "times in 12," "4 is contained in 12."

D. (*Derived*)—*Division.* (3.)

Question.—If $4 buy 12 yards, what will $1 buy?

Analysis.—If $4 buy 12 yards, $1 will buy ¼ of 12 yards, or 3 yards.

COMBINATIONS OF *A*, *B*, *C*, *D*.

C and A. Division and Multiplication.

Question.—If 4 yards cost $12, what will 9 yards cost?

Analysis.—First by *C* for price of 1 yard, then by *A* for price of 9 yards.

C and B. Division. (2) *and* (1).

Question.—If 4 yards cost $12, how many yards may be bought for $27?

Analysis.—First by *C* for price of 1 yard, then by *B* for number of yards.

D and A. Division and Multiplication.

Question.—If $4 buy 12 yards, what will $11 buy?

Analysis.—First by *D* for what $1 will buy, then by *A*, Note 2, for what $11 will buy.

NOTE.—*Avoid set forms of giving questions.*—Vary the order of statement as far as is consistent with perfect clearness. For instance, the "*C and B*" question might have been put thus: Spent $27 for cloth. How many yards did I buy, if $12 bought 4 yards?

EIGHTH GRADE.

1. Besides simple examples in the four fundamental rules and Federal Money, very simple operations involving practical applications of the selected tables of money,

weight and measure, should constitute a portion of the mental exercises in arithmetic.

2. Analogous exercises in Federal Money should be substituted for those in the simple rules, as soon as may be found expedient.

3. Exercises should be given to insure facility in reading and writing Federal Money, and in reducing, by inspection, and without analysis, dollars, etc., to cents or to mills, and conversely.

4. As soon as the class becomes fairly accurate in reading and writing Federal Money, examples should be given in addition and in subtraction—these subjects should be taught together. Multiplication examples may be given at the same time with those in addition and subtraction, for the only difficulty presented is the "pointing off." In teaching division the teacher should mark carefully the distinction between the two cases: 1. To find a part of a number. 2. To find how many times one number will contain another number.

5. Give examples of bills of purchase or sale involving several items and similar to those required in daily life.

6. In this grade, especially, it is advisable to advance with sufficient rapidity to allow time for a final review which will enable the pupils to know thoroughly the work of the grade.

SEVENTH GRADE.

1. A review of Federal Money should form a part of every grade up to the Fifth, inclusive, after which it blends with nearly all the other arithmetical exercises. It should form a part of the regular class-work each week, and at the monthly reviews.

2. "Practical applications" will include such questions as may be readily given in connection with the commonly used tables of money, weight and measure, etc.; as, "In $\frac{3}{8}$ lb. of sugar, how many oz.?" "Eighteen quarts are what part of a bushel?" Etc., etc.

3. In the written exercises pupils should use the signs of operation, +, −, ×, ÷, and the sign of equality, =, to indicate the work performed and the result.

4. At the outset the subject of fractions should, as far as possible, be made to coincide with the acquired experience and simple notions of a child.

SYLLABUS OF TOPICS.

(With Suggestions and Examples.)

I.—The *idea* of a fraction developed *objectively*.
The *equality* of the parts to be very carefully illustrated.
The *relative value* of various fractional parts, *as greater or less*.
The *definition* of a fraction.
The *terms* of a fraction defined, and the order of statement.
Exercises in writing and explaining fractions.
What *part* one *integer* is of another; as, 3 is what part of 7?
Show objectively that $\frac{2}{3}$ of $1 = \frac{1}{4}$ of 3.
A fraction involves division.
Fractional expressions *less than a unit—proper* fractions.
Fractional expressions *equal to or greater than a unit—improper* fractions.

NOTE.—The consideration of *compound* and *complex* fractions is reserved for the Sixth Grade.

II.—FUNDAMENTAL AXIOM, $1 = \frac{n}{n}$; or, $\frac{n}{n} = 1$.
Reduction of whole or mixed numbers to improper fractions.—Analysis A. (Page 101.)
Reduction of improper fractions to units.—Analysis B. (Page 101.)

III.—Changing fractions to higher terms. [What may halves, thirds, etc., be changed into? $\frac{1}{2}$? etc.] To be illustrated objectively. *Analysis C.* (Page 101.)

Divisors, or Factors.—Common Divisor, or Common Factor; Greatest

Common Divisor. Find these by inspection: for the *Greatest Common Divisor*, not more than two numbers to be used.

NOTE.—Too great importance can hardly be given to the exercise of inspection, for it is indispensable in many of the arithmetical exercises in every succeeding grade.

Reduction of fractions to lower terms. Give examples that can be solved by inspection; as, $\frac{36}{48}$, $\frac{45}{60}$, $\frac{1200}{1800}$, $\frac{250}{750}$, etc.

IV.—*Multiple*, identical with *product*: *Common Multiple*; also, *Least Common Multiple.*

Distinction between *common multiple* and *common denominator.*

Reduction of fractions to a common denominator—to their *least common denominator*: importance of reducing to the least common denominator. At first give but two fractions to be reduced, but speedily increase the number. Give examples involving preliminary reduction to lowest terms. Remember that the examples in addition and subtraction give abundant practice in "reduction"; therefore, do not delay the advance to the more practical work in fractions.

NOTE.—Say "*Reduce to least common denominator,*" rather than "*Find the least common multiple of the denominators*"; for the latter is only a part of the process of the former.

V.—Impossibility of adding together quantities with unlike names; also, of subtracting quantities from unlike quantities. "Add 4 apples and 3 peaches," etc., etc.

Adding and subtracting like things, also, fractions with like denominators—the indispensable basis for all addition and subtraction of fractions.

Addition and Subtraction of Fractions of different denominations. These subjects should be taught together. Give two fractions, such as $\frac{3}{4}$ and $\frac{4}{5}$, and require both their difference and their sum, mentally; then write on the blackboard the steps by which the answers were obtained—all the steps are alike except the final one—finding the *sum* or the *difference* of the numerators.

NOTE.—Avoid saying "*Subtract their numerators.*"

Addition and Subtraction of Mixed Numbers, to be taught together. The addition presents no special difficulty. The subtraction presents two forms of the same difficulty: $12-7\frac{5}{11}$, and $12\frac{3}{10}-9\frac{7}{12}$.

NOTE 1.—Avoid reducing mixed numbers to improper fractions.

NOTE 2.—Questions should occasionally be varied by asking "Which is the greater?" "What is the difference?" etc.

NOTE 3.—Give practical examples involving both addition and subtraction.

GENERAL NOTE.—Teachers should remember that arithmetic is not only a *science*, but also a practical *art*; that this art involves important *devices*, many of which have already been taught and the principles of which have been explained. These devices, such as reducing to lowest terms, rejecting terminal 0's of a divisor, etc., should not at any time be lost sight of. Examples of such character as to require these devices should be given occasionally in the special subjects of each grade. The omission or neglect of these important matters will be a serious defect in the character of the instruction given.

FORMS OF ANALYSIS.

Analysis A.—Example.—Reduce $5\frac{1}{2}$ to halves, or to an improper fraction: $1 = \frac{2}{2}$; $5 = 5$ times $\frac{2}{2} = \frac{10}{2}$; $\frac{10}{2} + \frac{1}{2} = \frac{11}{2}$.

Analysis B.—Example.—Reduce $\frac{15}{2}$ to units, or to a whole or mixed number: $\frac{2}{2} = 1$; $\frac{15}{2} = \frac{15}{2} \div \frac{2}{2} = 7\frac{1}{2}$. This may be expressed, also, as follows: Since $\frac{2}{2} = 1$ unit, $\frac{15}{2}$ will equal as many units as $\frac{2}{2}$ are contained times in $\frac{15}{2}$; or will equal $7\frac{1}{2}$.

Analysis C.—Example.—Reduce $\frac{2}{3}$ to ninths: $1 = \frac{9}{9}$; $\frac{1}{3} = \frac{3}{9}$; $\frac{2}{3} = 2 \times \frac{3}{9} = \frac{6}{9}$.

In teaching this analysis, attention should be carefully called to the fact that, if *both terms* of a fraction be multiplied by the same number, the *value* of the fraction will remain unchanged. Example: Reduce $\frac{3}{7}$ to twenty-eighths: multiplying denominator and numerator by 4 we have $\frac{3}{7} = \frac{12}{28}$.

NOTE.—By *Analysis C* it is shown that $\frac{2}{3} = \frac{6}{9}$. From this it is evident that, conversely, $\frac{6}{9} = \frac{2}{3}$; or, if *both terms be divided by the same factor, the value of the fraction will not be changed.* Or, again, if the question be asked, "6 is what part of 9?" the immediate answer will be $\frac{6}{9}$. If the same question be modified into "Two 3's are what part of three 3's?" the answer becomes $\frac{2}{3}$. Hence, it will be sufficient to say that a fraction is reduced to its lowest terms by dividing both terms by their greatest common divisor, because this does not change its value.

SIXTH GRADE.

1. Particular care should be taken in the selection of examples that no one of them be so intricate and prolix as to consume a large amount of time without affording

proper exercise of thought in the application of arithmetical principles.

2. Too much importance, nevertheless, can scarcely be given to the requirement of rapid calculation in the simple rules of arithmetic, for no part of the arithmetical discipline has a higher utilitarian value whether for the purposes of practical life or for progress in the more advanced portions of the study. Nothing is more discouraging to the pupil than to find that, from his want of accuracy in the simple rules, his results are frequently incorrect.

3. It will be readily perceived that solutions which follow the steps of a logical analysis are much more tedious than those which follow a rule derived from the result of the analysis. The methods by analysis, though essential to the proper teaching of the principles of arithmetical computation, should be employed in written arithmetic no longer than is absolutely required for the accomplishment of such a purpose: this caution is especially applicable to the methods by analysis employed in this grade.

SYLLABUS OF TOPICS.

Cancellation.—Its identity with *dividing by common factors*, and with *reducing to lowest terms.* Show this by examples in fractions.

Examples of simple applications of cancellation to whole numbers.

Compound fractions defined and illustrated.

MULTIPLICATION OF FRACTIONS.

Multiplication of fraction by integer.

Multiplication of mixed number by integer. Teach both methods.

Converse of these two cases.

Multiplication of fraction by fraction.

Compound fraction same as this case.

Multiplication of mixed numbers and fractions. Generally reduce the mixed numbers to improper fractions; also, *cancel before multiplying.*

RE.—In this last case it is sometimes more convenient not to reduce ixed number; as, $125\frac{3}{8} \times \frac{1}{2}$, $12\frac{1}{4} \times \frac{2}{3}$.

amples involving preliminary reduction to lowest terms.

:amples to be given in a practical form at as early a stage as can be e expedient.

nd how many cents or mills in a given fraction of a dollar.

he following explanations and suggestions will be found useful:

ultiply $\frac{1}{7}$ by 12; 12 times $\frac{1}{7} = \frac{12}{7} = 5\frac{1}{7}$.

ultiply $\frac{3}{8}$ by 12; 12 times $\frac{3}{8} = \frac{36}{8} = 4\frac{4}{8} = 4\frac{1}{2}$. This result would be re readily reached by the cancellation of the common factor, 4, in multiplier, 12, and the divisor, 8. *Whenever possible, cancellation uld be used.*

Find $\frac{3}{4}$ of 12; $\frac{1}{4}$ of $12 = 3$; $\frac{3}{4}$ of $12 = 3 \times 3 = 9$.

Find $\frac{1}{7}$ of 12; $\frac{1}{7}$ of $12 = \frac{1}{7}$ of 3 times $12 = \frac{1}{7}$ of $36 = 5\frac{1}{7}$.

Find $\frac{19}{19}$ of 12. Use cancellation.

Find $\frac{3}{4}$ of $\frac{8}{11}$; $\frac{1}{4}$ of $\frac{8}{11} = \frac{2}{11}$; $\frac{3}{4}$ of $\frac{8}{11} = 3 \times \frac{2}{11} = \frac{6}{11}$.

Find $\frac{3}{4}$ of $\frac{7}{11}$; $\frac{1}{4}$ of $\frac{1}{11} = \frac{1}{44}$; $\frac{1}{4}$ of $\frac{7}{11} = \frac{7}{44}$; $\frac{3}{4}$ of $\frac{7}{11} = 3 \times \frac{7}{44} = \frac{21}{44}$.

Find $\frac{1}{8}$ of $\frac{6}{11}$. Use cancellation.

Division of Fractions.

Division of fraction by integer. Solve as *compound fractions.*

Division of mixed number by integer. Solve as *compound fractions.*

Converse of these two cases. (See below.)

Division of fraction by fraction. (See below.)

Quotients of mixed numbers and fractions. (See below.)

Examples in finding what part one fractional quantity is of another.

Complex fractions—best considered as cases of *division of fractions.*

NOTE 1.—The form of putting the questions should be varied as much as possible, so as to train the pupils to select and apply the right principle and method; as, $\frac{3}{5}$ yard is what part of $1\frac{1}{5}$ yard?

Introduce practical examples as soon as possible. The teacher should always keep in mind, and should impress on the pupils, that the analyses of such examples correspond exactly with those of similar examples in the Eighth Grade, the essential difference being that fractional numbers now take the place of integers.

The question: "If $\frac{1}{7}$ of a yard cost $\$\frac{3}{8}$, what will a yard cost?" involves the finding of the cost of $\frac{1}{7}$ of a yard.

"If $\$\frac{3}{4}$ buy $\frac{1}{7}$ of a yard, how much will a dollar buy?" involves $\$\frac{4}{7}$.

NOTE 2.—Give examples involving simple combinations of multiplication and division of fractions; also, of addition or subtraction with multiplication or division. The following are suggestive:

Bought $7\frac{3}{4}$ yards and $3\frac{1}{2}$ yards at $\$1\frac{3}{4}$ a yard; what was the cost of the whole?

Bought 36 yards, kept $9\frac{1}{2}$ yards, sold the remainder at $\$\frac{1}{3}$ a yard; how much did I get for it?

If I had sold it for $\$7\frac{1}{2}$, how much a yard would that be?

If $\frac{3}{4}$ yard cost $\$\frac{9}{4}$, what will $\frac{8}{10}$ yard cost?

If $\frac{3}{4}$ yard cost $\$\frac{9}{4}$, how much can be bought for $\$5\frac{3}{5}$?

The following explanations and suggestions will be found useful:

Divide 9 by $\frac{4}{7}$ (first method), $9 = \frac{63}{7}$; $\frac{63}{7} \div \frac{4}{7} = \frac{63}{4} = 12\frac{3}{4}$.

Divide 9 by $\frac{4}{7}$ (second method), $9 \div \frac{1}{7} = 7 \times 9 = 63$; $9 \div \frac{4}{7} = \frac{1}{4}$ of $63 = 12\frac{3}{4}$. From this method it is seen that the dividend has been multiplied by 7, and the product divided by 5; or, in other words, *the dividend has been multiplied by the divisor inverted.* The method of division by inverting the divisor is preferable, as it more frequently permits cancellation and thus shortens processes.

Divide 9 by $3\frac{1}{7}$. Reduce the divisor to an improper fraction.

Divide $\frac{3}{10}$ by $\frac{4}{7}$: $1 \div \frac{4}{7} = \frac{7}{4}$; therefore, $\frac{3}{10}$ of $1 \div \frac{4}{7} = \frac{3}{10}$ of $\frac{7}{4} = \frac{21}{40}$.

Divide $7\frac{3}{10}$ by $4\frac{4}{7}$. Reduce to improper fractions.

FIFTH GRADE.

1. The exact nature of decimal fractions should be explained and illustrated; also the meaning of the word, *decimal.* Show that decimal fractions may be used like common fractions by writing the denominator. Illustrate by the decimal notation, showing that whole numbers greater than 9 are also expressed *decimally.*

2. The illustrations may embrace the following: 1. How to write decimals, as 7-tenths, 7-hundredths, 7-thousandths, 7-ten-thousandths, etc. 2. Show that the *numerator*, as in common fractions, is written *first.* 3. Show that the "decimal point" and the cipher, when used, are only required to *indicate the denominator.* 4. In *reading* decimal fractions the pupils should be cautioned to avoid such expressions as "tens of thousands" for *ten-thousandths*, "hundreds of thousands" for *hundred-thousandths*, etc., etc. In connection with the reading of such fractions,

pils should be trained to recognize readily the comparave value of different fractions; as, that .3 is greater than 987, or .01 than .009596, etc. They may also be made perceive readily the approximate value of decimals as ompared with simple common fractions; as, that .7634 is little more than $\frac{3}{4}$; that .8741 is somewhat less than $\frac{7}{8}$, etc. Previous to this, however, it is well to teach the exact value of certain decimal expressions; as, .75=$\frac{3}{4}$, .125 =$\frac{1}{8}$, .375=$\frac{3}{8}$, etc.

SYLLABUS OF TOPICS.

Reading and Writing Decimal Fractions.—(Utilize the pupils' knowledge of Federal money.)

The meaning of the term, *decimal.*

Show that all of the arithmetic learned previously to entering upon fractions is *decimal* arithmetic; that the system commonly used for writing numbers is called the *decimal system of notation*, and that it depends upon the "*device of place.*"

Examples: 28, two places or terms; 3207, four places or terms, are examples of decimal notation by "device of place."

MDCCXLIV, is a number written *without* this "device of place."

Show that 2 ft. 5 in., and 3 bu. 2 pks. 7 qts. 1 pt. are not decimal quantities: also that 3 sevenths ($\frac{3}{7}$) is not a decimal expression. Show that *among common fractions* there are certain ones whose successive denominators follow the scale of the decimal arithmetic, such as $\frac{3}{10}$, $\frac{5}{100}$, $\frac{306}{1000}$, $\frac{8255}{10000}$, etc., and that such fractions are, for that reason, called *decimal fractions*, and that they may be written in several ways; as, eight-tenths, 8 tenths, $\frac{8}{10}$, .8.

From the last example, show that a decimal fraction is a fraction whose *denominator* is 10, 100, 1000, etc., and whose *denomination* may be *indicated* by a point, called the "*decimal point*," together with the *decimal place or places occupied by the numerator.*

Show that in a decimal fraction the numerator and the denominator are indicated in the *same line*, though *read separately* as in all other common fractions.

Exercises in telling how many places are necessary for a given denominator, and *vice versa.*

Changing decimal fractions to higher or lower terms: First by *inspec-*

tion, with analysis as in common fractions. *Examples*, mental & written:

.3 to .00's, to .000's, etc. .15 to .00000's.

8 to .0's, to .00's, to 000's, etc. 7.3 to .0's, to .000's, etc.

.700 to *lowest decimal terms*, etc.

Changing common fractions to decimal fractions.

Use principle—$\frac{1}{4}$ of $1=\frac{1}{4}$ of 3; as follows:

Reduce $\frac{1}{4}$ to .0's—$\frac{1}{4}$ of $1=\frac{1}{4}$ of $3=\frac{1}{4}$ of 30 tenths$=.7\frac{1}{2}$.

Similarly, 3 is how many tenths of 7?

NOTE.—Pupils should be accustomed to read decimal fractions, especially hundredths (in subsequent grades applied to per cent.), so as to include outstanding fractional parts, where there are any.

Example.—Reduce $\frac{4}{11}$ to .00's.

$\frac{4}{11}=\frac{1}{11}$ of $4=\frac{1}{11}$ of 4.00 (four hundred hundredths)$=.36\frac{4}{11}$.

Reduce $\frac{3}{32}\frac{4}{0}$ to a decimal: $\frac{3}{32}\frac{4}{0}=\frac{3}{32}=\frac{3}{4}=\frac{1}{4}$ of $3=\frac{1}{4}$ of $3.00=.75$.

Give examples to show that a common fraction in its lowest terms can be made *entirely decimal* only when every prime factor of its denominator is either 2 or 5. In the general work of the class, pupils should rarely be required to continue the division beyond three or four places.

Reducing decimal fractions to common fractions in their lowest terms.

Rule.—Write the fraction as a common fraction and reduce to lowest terms.

Examples: .625, .4125, .87500, 14.125.

Examples: .07$\frac{1}{7}$, .3$\frac{1}{3}$, .66$\frac{2}{3}$, 5.11$\frac{1}{9}$, .87$\frac{1}{2}$.

Examples of this class may be solved very simply as follows:

$.07\frac{1}{7}=7\frac{1}{7}\times\frac{1}{100}=\frac{50}{7}\times\frac{1}{100}=\frac{1}{14}$.

Pupils should be made thoroughly familiar by rapid mental exercise, usually without analysis, with the decimal expressions for halves, 3ds, 4ths, 5ths, 6ths, 7ths, 8ths, 9ths, 11ths, 12ths, and *vice versa*, using preliminary reduction to lowest terms only when necessary, as in $\frac{9}{12}$, $\frac{6}{9}$, etc.

Addition and Subtraction of Decimal Fractions.—Explain, as in common fractions, by principle of least common denominator; the necessary ciphers may be "understood" in the solution, when more convenient.

Examples: Add .2, .05, .008 and .7283. Find the sum of .0005, 9.97, 3.05 and 1.0101. From .1 take .075. Find the difference between .01009 and 1.001. .87$\frac{1}{2}$—.66$\frac{2}{3}$, .83$\frac{1}{3}$—.37$\frac{1}{2}$.

Multiplication of Decimal Fractions.—Use the brief rule of common fractions.—Do not give large denominators.

Cases as in common fractions:

1. *When a fraction or a mixed number is to be multiplied;* as, 4 times 75, 17 times 8.047, 100 times 9.625, 1,000 times 1.3.

Value of 13 barrels at $8.375 a barrel?

2. *When a fractional part is to be taken;* as, .4 of 83, .4 of .75, .4 of 3.75.

How much is .7 of $38.45? .079 of $120? .90½ of $160.48?

Value of .179 of ton @ $92 a ton? at $92.87½ a ton?

3. Combinations of the 1st and 2d cases; as,

3.4 lbs at 79 cts. a lb.? $.79 × 3.4;

8 cwt. 75 lbs. @ $2.47 a cwt.? $2.47 × 8.75.

NOTE.—As preliminary to 2d and 3d cases, give mental exercises in finding the *product of two decimal denominators*, as 10ths by 10ths, how many decimal places? 1,000ths by 100ths, how many decimal places? etc.

Examples of cases involving reduction:

.024 × .15 = ? Product of numerators, 24 × 15 = 360, the new numerator: 1,000 × 100 = 100,000, the new denominator. *Ans.*—.00360, in lowest decimal terms, .0036. Why cross off the last 0? To divide both terms by 10.

NOTE.—Many questions are as well solved by the application of a principle in common fractions, as follows:

.79 of $714.83 = 79 times .01 of $714.83.

Division of Decimal Fractions.—There are two cases:

1. *When the divisor is an integer:*

7÷8, 8÷7, 6÷5, 6÷120, 7.2÷6, 3.6÷120, 3.6÷100, etc. Put the question in several ways: 1st. Divide 7.2 by 6. 2d. How much is $\frac{1}{6}$ of 7.2? 3d. How many times is 6 contained in 7.2? etc.

2. *When the divisor is, or contains, a decimal fraction:*

6÷.03, .8÷.005, .004÷.8, .0036÷.024, 7.2÷.009, 8÷5.45, 3÷7.203, .2÷8.75, .3006÷7.4, 8.5÷9.78, 8.638÷9.5, 8.638÷4.3, etc.

All examples under this head are reducible to the first case by multiplying divisor and dividend by the same number, or by moving the decimal point of the divisor to the right until the divisor becomes an integer, and moving the decimal point of the dividend to the right a corresponding number of places.

Applications.—The most important applications of decimal fractions will be found in Federal money. Simple combinations with common fractions should occasionally be made; also simple combinations of two or more of the rules of decimal fractions.

Use the principles of cancellation and reduction to common fractions whenever they will simplify the operation. No class that has completed

multiplication of decimal fractions should be permitted to go thr[ough] the long process when finding .125 of a number.

Examples in finding what *decimal fraction* one number or quantity is of another, especially how many *hundredths*—use only small amounts or very simple examples:

8 cts., how many hundredths of 64 cts. ? $7.25, how many hundredths of $9.75 ? ½ A., how many hundredths of 1⅝ A. ?

Solutions as follows:

1st. What *common* fraction: $\frac{8}{64}=\frac{1}{8}$; $\frac{7}{9}\frac{2}{5}=\frac{2}{9}\frac{0}{5}$, etc.

2d. What *decimal* fraction: $\frac{1}{8}$=.125 or .12½ ; $\frac{2}{7}\frac{0}{9}$=.74$\frac{14}{39}$, etc.

The last case is the extreme limit of "applications" in this grade. Examples should never take the following involved form of statement: "Bought for $9.75, sold at $7.25 profit, how many hundredths did I gain ?"

General remarks.—It must not be forgotten that the teaching of *principles* and their most common and useful applications is the principal matter in the study of common and decimal fractions. Therefore, AVOID LONG EXAMPLES.

REDUCTION OF INTEGRAL DENOMINATE NUMBERS.—Review the tables taught in preceding grades, but in giving examples in reduction use the following tables only: Avoirdupois Weight, Troy Weight, Dry Measure and Liquid Measure.

See not only that all the tables are memorized, but that *they are understood.*

Reduction Descending.—Why so called. Denominations to be written. Do not allow pupils to "add in" by a separate line: it increases the work and the time and indicates mental feebleness. Explain by any process which makes the multiplier an abstract number. The "adding in" is identical with that in the reduction of mixed numbers. In giving examples, insert frequently the finding of the value at a given price.

Reduction Ascending.—Best taught and understood in immediate connection with reduction descending ; at first by reviewing the same example.

Explain by any process which will clearly account for the denominations of the successive quotients and remainders.

The necessary analyses have already been given in the preceding grades.

Give examples in finding the quantity purchased for a given sum of money at a given price for some small quantity, such as a pint, an [ounce], a grain, etc., etc.

Supplementary Note to the Arithmetic of the Seventh, Sixth and Fifth Grades.

Particular attention is directed to the three following elementary and mutually related problems, and to their importance as the essential preparation for the commercial arithmetic of the Third and higher grades.

1st. To take a fractional part of a given number:

Seventh and Sixth Grades.	*Fifth Grade.*	*Third Grade.*
How much are $\frac{4}{5}$ of 15 ?	How much are .75 of 15 ?	Find 75 per cent. of 15.
How much are $1\frac{1}{4}$ times $9\frac{1}{2}$?	How much are 1.25 times 9.50 ?	Find 125 per cent. of 9.50.
Value of $2\frac{1}{2}$ yards @ $\$5\frac{3}{8}$ a yard ?	Value of 2.50 yards @ $\$5.37\frac{1}{2}$ a yd. ?	Find 250 per cent. of $\$5.37\frac{1}{2}$.

2d. To find what (fractional) part one given number is of another given number :

6 is what com. fract. of 15 ?	6 is what dec. fract. of 15 ? 6 is how many 100ths of 15 ?	6 is what per cent. of 15 ?
$7\frac{1}{8}$ is what com. fract. of $9\frac{1}{2}$?	$7\frac{1}{8}$ is what dec. fract. of $9\frac{1}{2}$? $7\frac{1}{8}$ is how many 100ths of $9\frac{1}{2}$?	$7\frac{1}{8}$ is what per cent. of $9\frac{1}{2}$?
$\$4\frac{3}{4}$ are what com. fract. of $\$5\frac{1}{4}$?	$\$4\frac{3}{4}$ are what dec. fract. of $\$5\frac{1}{4}$? $\$4\frac{3}{4}$ are how many 100ths of $\$5\frac{1}{4}$?	$\$4\frac{3}{4}$ are what per cent. of $\$5\frac{1}{4}$?

3d. To find the number of which a given number is a given fractional part :

85 is $\frac{5}{8}$ of what number ?	85 is .625 of what number ?	85 is $62\frac{1}{2}$ per cent. of what number ?
$2\frac{1}{4}$ is $\frac{7}{8}$ of what number ?	2.25 is $.87\frac{1}{2}$ of what number ?	$2\frac{1}{4}$ or 2.25 is $87\frac{1}{2}$ per cent. of what number ?
$\$9\frac{1}{4}$ are $\frac{3}{5}$ of what sum ?	$9.25 are *1.80 of what sum ?	$9.25 are 180 per cent. of what sum ?

If these three principles are made reasonably prominent by simple practical examples in the Seventh, Sixth and Fifth Grades, a large part of the time and labor of the teachers of the higher grades will be available for other equally important objects.

* Should be read 180 hundredths.

FOURTH GRADE.

1. For the purpose of review, brief examples in fractions, both common and decimal, should be employed, so as to test and to fix more thoroughly in the pupil's mind a knowledge of the principles and applications of fractions as taught in the preceding grades. The improvement made by the pupils in accuracy and rapidity, as well as in the ready application of arithmetical principles to particular cases involving an exercise of the judgment and reasoning powers, should be progressive from grade to grade, and should be carefully tested in the mental work.

2. The special province of this grade being *Denominate Numbers*, the exercises, both mental and written, should deal largely with the applications of fractions to that class of numbers.

3. The arithmetic specially prescribed in this grade is of a practical character, perhaps more generally so than in any of the other grades of the course. All that precedes has been, to a considerable extent, a preparation for the work of this grade and will be found involved in it. In view of the great importance of the subject and in order to render the requirements as definite as possible, the syllabus given below presents, first, certain preliminary considerations; and, second, specific directions as to the extent of the field to be comprehended in the grade.

4. The whole subject of compound denominate numbers is strictly utilitarian. Practical utility should, therefore, be the controlling element in all the exercises employed. The daily necessities of the house, the shop, the market, etc., indicate the general character of the selections to be made. These will furnish at least as good mental discip-

line in calculation and analysis as those of a less severely practical character.

5. The average time which pupils in this grade can yet spend in school is short. Secure, therefore, the essentials first. Review and test thoroughly the indispensable basis —the tables; see not only that the tables are memorized but that they are understood: some of the tables have already been applied to the reduction of integral denominate numbers in the Fifth Grade. Train your pupils to work with reasonable rapidity. Carefully avoid long and complex examples. Avoid all things obsolete or obsolescent. Keep a clear record of the points you have covered; it will assist in the reviews and in the examinations. Do not dwell so long on Reduction as to omit important practical points in other rules.

SYLLABUS OF TOPICS.

Fractional Denominate Numbers.—Reject all examples in addition, subtraction, multiplication and division of fractional denominate numbers. In reduction *there are but two cases*, and the second of these is simply the converse of the first. Each divides into two varieties, in one of which the fraction is common and in the other decimal, but the principle applied in working is the same.

Be careful to select only those denominate numbers in which such fractional quantities are likely to need consideration, chiefly sterling money.

Examples: Case 1st. { A. $\frac{3}{4}$ of a bushel to pecks, quarts, etc. / B. .673 of a gallon, how many quarts, etc. ?

Examples: Case 2d { A. 3 pks. 5 qts. 1 pt., what common fraction of a bushel ? / B. 15 cwt. 38 lbs., what decimal fraction of a ton ?

Addition and Subtraction of Denominate Numbers.—*Subtraction* best taught in connection with *addition.*

Multiplication of Denominate Numbers.

Division of Denominate Numbers.—Note the distinction between the different cases.

NOTE.—Suggestions for the limitation of the application of these four

rules and of reduction of integral denominate numbers will be found below in connection with the "Weights and Measures."

Weights.—Teach briefly, by examples, the relations of Avoirdupois and Troy weights, the essential identity of Troy and Apothecaries' weights. Let most of the examples in reduction be in the first of the three. They should be few and very short in the last.

Remember that the quarter of a hundred weight and the avoirdupois dram are seldom used now excepting in text-books.

In addition and subtraction give avoirdupois weight. Remember that in things sold by the ton the ounce is not taken into account.

Linear Measure.—Employ the denominations most in use—inch, foot, yard, rod and mile. Give a few examples to show the use of the chain and its subdivisions.

Omit addition, subtraction, multiplication and division.

Surface Measure.—(*Of very great practical importance.*)—Be particular to avoid long examples. Give the feet, rods or chains in the sides of rectangles, to find acres and value; acres and hundredths the most usual form. Simple questions, involving cost, should be given in carpeting, plastering, paving, dress-lining, etc. Omit reduction, except where it may be needed in the practical examples indicated above. Omit addition, subtraction, multiplication and division.

Solid Measure.—See that pupils understand the mutual relations of linear, surface and solid measures. Give examples in finding cubic inches, feet or yards in boxes, bins, tanks, cisterns, cellars, etc.; also, contents in bushels and gallons. Find cords in a pile of cord wood. Omit reduction, except where it may be needed in the practical examples indicated above. Omit addition, subtraction, multiplication and division.

Dry and Liquid Measures.—Use no obsolete denominations. Omit beer measure. Remember that the barrel and the hogshead are not often measures in commerce. Simple examples in reduction, multiplication and division.

Circular Measure.—Treat briefly; explain the terms and their use; omit *signs*. Addition and subtraction, applied to questions in difference of latitude and longitude; reduction, where needed for finding difference in time.

Time.—Difference of dates by days, and by years, months and days.

Miscellaneous.—Practical examples in values, involving dozen, gross, quire, ream, quintal; barrels of flour, beef, etc., making out simple bills, receipts, etc.

THIRD GRADE.

1. The teacher is enjoined to bear in mind that, in teaching business arithmetic, it is especially important to insist upon clearness, neatness, legibility, accuracy in results and reasonable rapidity. Mental exercises corresponding to the written should form a large part of the work of this grade.

2. The introduction of the various forms of Percentage constitutes the chief difference between the commercial arithmetic of this grade and that taught in the preceding grades.

3. The divisions of this subject should be presented in the following order: First, *Simple Percentage;* second, the *applications* of Simple Percentage, technically known as *Trade Discount, Profit and Loss, Brokerage, Commission, Insurance, Taxes*, etc.

4. In treating this subject many skilful teachers prefer to introduce algebraic formulæ in which the initial letters of the several terms employed in Percentage are the elements. To this course there is no objection, provided that the usual analysis be not neglected.

5. The subject of arithmetic being necessarily and to a great extent cumulative, the teacher of the Third Grade is especially advised to read over the directions given in all the preceding grades, and in particular the table on page 109. For the sake of brevity, the terms *base, percentage*, etc., are employed in the following Syllabus of Topics in the usual technical sense of the text-books: the teacher will use them or not, as the Principal may deem expedient.

SYLLABUS OF TOPICS.

The term *percentage*—Reading per cent.

Examples.—Read the following decimal fractions as per cent.: .75, .8, .605, .003, .08½, .00⅔, etc.

Change common fractions to per cent., and *vice versa*:

Examples.—$\frac{1}{4}$, $\frac{7}{8}$, $\frac{440}{500}$, $\frac{33}{88}$, $2\frac{1}{4}$, $1\frac{3}{11}$, $\frac{1}{17}$, etc.

25 per cent., 75 per cent., 33⅓ per. cent., 14⅔ per cent., 88⅔ per cent., 825 per cent., 137½ per cent., etc.

The common business fractions—halves, thirds, etc., to twelfths, inclusive—should be reduced to per cent., and the pupils should be made thoroughly familiar with them.

Fundamental Case.—To find the *percentage* when the *base* and *rate* are given.

See table, page 109.—*To find a given fractional part of a given number.*

Examples.—How much is 9 per cent. of 750? Had $750 in the bank; drew out 9 per cent. How much was it?

Analysis as in the multiplication of decimal fractions.

Modifications:

Examples.—Had $750; paid out 9 per cent. How much had I left? Had $750; earned 9 per cent. more. How much had I then?

Give a simple example in the fundamental case, then let the pupils derive the other cases from it. It is not essential that these cases be derived in any given order: let the pupils form other questions from the given example and thus discover, if possible, the separate cases.

Derived Case.—To find the *rate* when the *percentage* and *base* are given.

See table, page 109.—*To find what fraction one number is of another number.*

Examples.—140 is what per cent. of 400?

Had 400 sheep; sold 140. What per cent. did I sell?

Analysis as in reducing a common fraction to a decimal fraction whose denomination is hundredths.

Modifications:

Examples.—I had 400 sheep; I now have 540. What is the per cent. of increase?

I had 400 sheep; I now have only 260. What is the per cent. of decrease? Or, what per cent. have I left?

Derived Case.—To find the *base* when the *percentage* and *rate* are given.

See table, page 109.—*To find the number of which another number is a given fraction.*

Examples.—140 is 35 per cent. of what number?

Sold 140 sheep, which was 35 per cent. of my flock. How many had I at first?

Analysis as in simple fractions—140 is $\frac{35}{100}$ of what number?

Modifications:

Examples.—Sold 140 sheep, which was 35 per cent. of my flock. How many had I left?

Sold 140 sheep, and have 65 per cent. of my flock remaining. How many had I at first?

Derived Case.—To find the *base* when the *amount*—or the *difference*—and *rate* are given.

To find a number which differs by a given fractional part of itself from a given number.

Examples.—What number is by 8 per cent. of itself more than 276? or, 324 is 8 per cent. more than what number?

My flock of sheep increased 8 per cent.; I then had 324. How many had I at first?

I lost 8 per cent of my sheep, and had 276 remaining. How many had I at first?

Analysis. { First, find the per cent. represented by the given number, thus: 100 per cent. − 8 per cent. = 92 per cent.
Second, 276 is $\frac{92}{100}$ of what number?

Trade Discount, Commission, etc., are but other applications of Simple Percentage. They require no special additional teaching, except in regard to the technical terms employed.

SECOND GRADE.

1. In this grade, the teaching consists in large part of a review of what has gone before, with exercises sufficient in number and difficulty to familiarize the pupils with the principles and to render them expert and accurate in their applications. For suggestions in regard to this part of the work, the teacher is referred to the preceding grades.

2. The advanced work comprises the following: *Interest —Simple and Compound; Discount; Simple Proportion.* The exercises employed to teach these departments of arithmetic should be of as practical a character as possible.

A knowledge of the business transactions involved and of the terms employed in any of the rules of their applications, should always be imparted to the pupils before they are required to solve the problems. Failure arises more frequently from a want of this knowledge than from a deficiency in arithmetical attainment.

3. The following syllabus contains a brief summary of what is suggested to be taught in this grade:

SYLLABUS OF TOPICS.

INTEREST.—Teach the definitions of the terms—the distinction of simple from compound interest—the legal rate of the United States and of the State of New York.

In classes of an average character, *one* good method will be found to give better results than two or more. Whatever method be employed, the pupils should, from the first, be guarded against considering and calling the multiplier a concrete number.

If the six per cent. method be employed, the pupil should not be allowed to sacrifice sense to conciseness by such statements as "the half of 7 months is 3 cents and a half"—"one-sixth of 24 days is 3 mills," etc. As a preliminary to applying this method, the class should have a thorough training on such questions as the following: In 2 years 3 months and 20 days, at 6 per cent. per annum, the interest will be *what decimal fraction of the principal?*

In finding interest *at any given rate* by the six per cent. method, the interest on the *principal* should be found at six per cent. first; afterward, it should be increased or decreased, as may be required: by so doing, difficult fractional multipliers will be avoided.

Give examples involving the various forms of the difference of dates.

Example.—Find the interest of $340 from January 5, 1886, to July 5, 1889, at 6 per cent.

Examples involving the method of exact interest, when the year is

estimated to consist of 365 days, should also be given. This is one of the most important of the business methods.

Example.—Find the exact interest of $340 from December 1, 1883, to January 27, 1884, at 4 per cent.

In teaching the derived cases of simple interest, begin with an easy example in the fundamental case; from that derive the others, being particularly careful to teach that, being derived, they all require division: to find the *rate*, the given interest is to be divided by the interest at 1 per cent.; to find the *time*, the given interest is to be divided by the interest for one year; to find the *principal*, in one case, the given interest is to be divided by the interest of a principal of $1—in another case, the given amount is to be divided by the amount of $1 (the case used in *True Discount*).

Compound Interest should be very briefly treated, and with very simple examples.

The form and nature of a promissory note, the meaning of the several terms applicable to it, and the forms of bills and receipts are included in the work of this grade.

Discount.—Give examples in *Bank Discount;* also in *True Discount*, distinguishing carefully its differences in principle and method from *bank* and from *commercial* discount.

PROPORTION.—*Ratio;* ratio of 4 to 12, 4 : 12, $\frac{4}{12}$; *proportion;* relation of antecedents and consequents; method of finding the missing term. Problems should be only such as are required to illustrate the principle, since they are ordinarily to be solved by analysis previously given.

FIRST GRADE.

Every *topic* to be treated in this grade should be introduced by mental exercises, the slate being used only when the numbers involved are too large to be readily retained in the mind without being written. The pupils should be constantly practiced in this mental work.

Great care should be exercised in assigning lessons for home study in this branch.

SYLLABUS OF TOPICS.

1. EXCHANGE.—Its nature; bills of exchange; par of exchange; acceptance; domestic exchange—to include two cases: 1. To find the

cost of a draft when its face and the rate are given ; 2. To find the face, the cost and rate being given. Foreign exchange, including consideration of bills on England, France and Germany :

(Teach table of English money; also, the proclaimed Custom-house valuation of the *pound sterling*—$4.8665 ; of the *franc*—$.193; of the German *mark*—$.238.)

NOTE.—For the varying current exchange values of the foreign money units, *the pound, the franc, the mark*, etc., consult the daily papers. Exchange on "London, $4.81," for instance, would show that sum to have been the market value of the pound sterling on that day. In the same way, "Paris (francs), 5.24," means that 5 francs and 24 centimes were sold for one dollar; and "Hamburg (marks), 94¼," that four marks were sold for 94¼ cents.

2. EQUATION OF PAYMENTS.—Cases: 1. To find average time of payment, when the items have the same date, but different credits: 2. When the items have different dates; 3. To find the average time for paying balance of account, having both debits and credits. Analysis on the principle of interest; reduction of each principal involved to $1 preferable.

The examples given should be of a very simple character, merely full enough to show the application of the principle.

3. CUSTOM-HOUSE BUSINESS.—Meaning of the following terms, with illustrations: Customs, Custom-house, Port of Entry, Collector of Port, Tariff, Duties—Specific and Ad Valorem, Invoice, Gross, Net, Tare, etc.

4. PARTNERSHIP.—Terms defined. Cases: 1. To find each partner's share when the profit or loss is divided according to capital only. 2. To find it when time is considered.

5. MENSURATION.—Include at least the following cases: 1. To find the area of a parallelogram, triangle, trapezoid and circle. 2. To find the diameter or circumference of a circle. 3. To find the solid contents of a cube, square prism, square pyramid, cylinder, cone and sphere.

TABLES OF WEIGHTS AND MEASURES.

[GENERAL NOTE.—Pupils should be carefully taught the *meaning, uses* and *simple practical applications* of these Tables.]

EIGHTH GRADE.

The teaching of the Tables should be restricted to the following:

1. *Review* thoroughly the Tables taught in Grades I. and II. of the Primary course.

2. *Federal Money.*—Complete the table, including *eighths* of the dollar. The difference between the full table and money of accounts. Do not permit the use of the terms, *penny* and *shilling.*

3. *Length.*—Add the following: 1,760 yards = 1 mile; 5,280 feet = 1 mile.

4. *Surface.*—144 square inches = 1 square foot; 9 square feet = 1 square yard.

5. *Solidity.*—1,728 cubic inches = 1 cubic foot; 27 cubic feet = 1 cubic yard.

6. *Dry Measure.*—Add the following: 2,150.4 cubic inches = 1 bushel. It will be sufficiently accurate, if the fraction be omitted.

NOTE.—A box whose interior is a foot square and fifteen inches deep will contain a very little more than a bushel.

7. *Liquid Measure.*—Add the following: 231 cubic inches = 1 gallon.

NOTE.—A box eleven inches deep, seven inches long and three inches wide will hold just one gallon.

Note, also, that the dry quart is about one-sixth greater than the liquid quart.

8. *Avoirdupois Weight.*—Add the following: 20 hundred weight = 1 ton; 2,240 pounds = 1 long ton, or old ton.

NOTE.—The pound avoirdupois = 7,000 grains troy; the ounce = 437½ grains troy.

9. *Time Table.*—Add the following: Leap year; use of a calendar.

10. *Miscellaneous Table.*—Add the following: 12 dozen = 1 gross; 144 things = 1 gross; 20 quires = 1 ream of paper.

SEVENTH GRADE.

The teaching of the Tables should be restricted to the following:

1. *Review* thoroughly the Tables taught in preceding grades (Primary and Grammar).

2. *Length* (*Miscellaneous*).—4 inches = 1 hand; 3 feet = 1 pace; 6 feet = 1 fathom; 1⅛ mile (very nearly) = 1 knot, or nautical mile.

3. *Avoirdupois Weight* (*Miscellaneous*).—60 pounds = 1 bushel of wheat; 196 pounds = 1 barrel of flour; 200 pounds = 1 barrel of beef or pork; 100 pounds = 1 quintal of fish (dry); 1,000 ounces (62½ pounds) = 1 cubic foot of water.

4. *Troy Weight.*—The usual table.

NOTE.—The pound Troy contains 5,760 grains; the ounce, 480 grains.

5. *Apothecaries' Weight.*—The usual table. The *pound*, *ounce* and *grain* identical with those of Troy Weight: the only difference consists in the subdivision of the ounce.

6. *Apothecaries' Fluid Measure.*—60 minims, or drops = 1 fluid drachm; 8 fluid drachms = 1 fluid ounce.

7. *Angular Measure.*—60 seconds = 1 minute; 60 minutes = 1 degree: teach the *notation*, and give examples in reading; as, 16° 17′ 45″. Review the following terms: *circle*, *circumference*, *diameter*, *radius*, *quadrant*. The circumference contains 360 degrees; the quadrant, 90 degrees. Show the use of this table in Geography.

NOTE.—The circumference is very nearly 3⅐ times the diameter of the circle.

SIXTH GRADE.

The teaching of the Tables should be restricted to the following:

1. *Review* all the Tables in preceding Grades (Primary and Grammar).

2. *Length.*—Add the following: 5½ yards = 1 rod; 320 rods = 1 mile.

3. *Length* (*Surveyors' Measure*).—66 feet = 1 chain; 80 chains = 1 mile: also, 4 rods = 1 chain; 100 links = 1 chain.

NOTE.—The link is nearly 8 inches in length.

4. *Surface.*—Add the following: 30¼ square yards = 1 square rod.

5. *Surface* (*Surveyors' Measure*).—16 square rods = 1 square chain; 10 square chains = 1 acre; 640 acres = 1 square mile, or *section;* 36 square miles = 1 *township.* Explain the use of the terms, *section* and *township*, as applied to land surveyed by the United States Government.

PENMANSHIP.

SUGGESTIONS.

Penmanship is prescribed to be taught in each grade of the Grammar School Course: in addition to this constant practice is also required in *writing with the pencil.* By means of the latter much can be accomplished in insuring

to the pupil readiness and fluency in the exercise of penmanship.

The exercises in written spelling, composition, etc., should be performed with accuracy, even if some sacrifice of rapidity be at first required. Of course, there should be a constant effort to improve both in rapidity and accuracy—*quantity* as well as *quality* being made a criterion of merit and success.

The writing with the pencil should, as far as it is practicable, exemplify the principles and methods formally taught in the lessons in penmanship. Pupils should not be permitted to violate in one class of exercises the rules and precepts taught and practiced in another. This is especially applicable to the holding of the *pencil*, which should be sufficiently long to be held as a *pen*.

The lessons on *penmanship* should be methodical and progressive, whatever system may be employed. In the lower grades the exercises should be rudimentary, but the pupil should not be retained in them too long. He should be permitted to *write* as much as possible: making *strokes* and *curves* is not *writing*.

The use of *trial papers* should be reduced to the minimum: the pupil should be taught the necessity of doing everything as well as he can do it; but perfection in details should not be expected in the rudimental stages. It should, *from the first*, be deemed essential (at least *meritorious*) to execute the prescribed work with dispatch, provided there is no want of care or attention.

A proper distinction should be made between the lessons given to show the pupils how to write and the exercises designed to practice them on what they have thus learned. In the former, the whole class should invariably be occupied in the same work, the teacher ex-

plaining, and illustrating from the blackboard, the principles and methods which form the subject of the lesson; in the latter, practice being the object in view, it is not essential that all the pupils should be doing the same thing at the same time, although even here it is a convenience to the teacher, since it facilitates supervision.

It should be carefully kept in view that the *hand* and the *eye* as well as the *mind* of the pupil are to be trained in this branch of instruction—the *hand* to execute, the *eye* to discern, the *mind* to judge. These are not to be educated separately and successively, but simultaneously.

A correct method of holding the pen, a proper position of the body while sitting at the writing-desk, and a suitable placing of the book or paper, are highly conducive to the acquisition of a good handwriting. Every lesson should, for some time, be introduced by distinct directions as to the proper method of holding the pen, and these the pupils should not be permitted to violate. With regard to the position of body and position of book, a few simple directions will be all that are requisite. The teacher should see that the pupils sit in such a position as to allow perfect freedom of motion of the right hand and arm, ease of respiration, and as much physical ease otherwise as the seat and desk will permit.

The books should, if possible, be provided with covers and blotters; the pens should be carefully cleaned at the end of each lesson, and should be changed as often as necessary; and the ink should be kept in the best condition. Each page of the book should end with the name of the pupil and with the date.

In the higher grades the writing of copies, consisting each of a single line, should be discontinued; and paragraphs, verses, business forms, notes, superscriptions, etc.,

hould take their place. In fact, it is not essential that opy-books should be used in all classes in a school: *the opy-book is a means to the end—a good handwriting;* and, as soon as this end has been reached in any school, the copy-book may be laid aside, and all of the practice in penmanship may be applied to dictation exercises, copying compositions, etc. In all grades, from the very lowest, in which copy-books may be used, it is advisable to have the pupils use the lower part of each page for copying corrected dictations, etc. The exercises in book-keeping should be made subservient to the instruction in penmanship, writing up the usual blank-books being made, to some extent at least, a substitute for the use of copy-books. Various styles of writing should be taught, as far as time and opportunity may permit—as the business style, epistolary style, engrossing style, etc.: it is advisable, also, to *let the pupils* have some practice in writing on paper without lines. This has reference to the Female as well as to the Male Grammar Schools.

FREE-HAND DRAWING.

Suggestions.

The course in drawing for the primary classes has been designed to familiarize the pupils with the use of the pencil in drawing (free-hand) straight and simple curved lines in different positions; to teach them to draw lines of given lengths; and to divide lines into equal parts; to cause them to make applications of this elementary work in drawing various plane figures; and to give them some idea of symmetry as shown by simple arrangements of straight and curved lines in plane figures. With this preparation the pupils of the Grammar Grades should be able,

without any great difficulty, to accomplish the work laid down for them. In what follows, work of the same character, extending through several grades, is considered under one general head, and not in detail in the separate grades: notes are also made under each grade when necessary.

Lead Pencils.—A very soft pencil should not be used for sketching, as it interferes with the neatness of the drawing: a hard pencil should not be used for strengthening lines, as it makes depressions in the paper. If but one pencil be used, let it be of a medium grade.

In sketching the pencil should be held lightly, at least an inch from the point; in strengthening a line the pencil may be held nearer the point. Use the point of the lead for fine lines, the side of the lead for stronger ones.

Erasers.—In general the eraser is necessary, but it should be used as seldom as possible. To impress upon pupils the necessity of carefulness, have them draw a figure occasionally without the eraser.

Mechanical Aids.—Mechanical aids, such as rulers, measures, and compasses, may be used with advantage in the following cases: a plane figure which is to inclose a symmetrical arrangement or a design; construction lines of such arrangement or design; lines that contain a border or that separate its units.

The construction lines of vases and of conventionalized leaves and flowers are sufficiently simple to be made without mechanical aids.

Blackboards.—In each grade the blackboard should be used by the teacher to illustrate the *method* of drawing the figure or of forming the design under consideration: the slate or paper may be used by the pupils to follow rapidly the successive steps of the teacher.

While it is preferable that the teacher's blackboard etching should be neat and accurate, it is not essential for his point of the instruction: it is essential, however, that drawings which are to be *copied*, whether from chart or blackboard, should be as accurate as it is possible to make them.

Plane Figures.—All the plane figures are sufficiently simple to be drawn without mechanical aids.

Symmetry.—In forming a bi-symmetrical figure the principal axis should be drawn first, the transverse auxiliaries next, and then the outline. If the principal axis be vertical the left-hand portion of the figure should be drawn first; if horizontal, the upper portion first. These suggestions are often applicable in drawing vases and conventionalized leaves.

Borders.—In drawing horizontal borders it will be well, after the construction lines have been made, to complete the left-hand unit before beginning the next: in drawing vertical borders begin at the top.

Leaves and Flowers.—Encourage pupils to gather leaves and flowers appropriate to the grade, and teach them to conventionalize them: by this means the pupils will be led to seek originality in design, a most important point in the instruction in drawing.

Vases.—As it is almost impossible to have a sufficient variety of vases in any school, ask the children to note carefully the forms of such as they may see elsewhere. Have them sketch these rapidly, as they may remember them: from these sketches make selections for general class-work. By preserving the best forms thus ga[illegible] each teacher may, in the course of a few terms, possessed of a great variety.

Original Designs.—In designs for wal[illegible]

means of compasses: afterward have the pupils d... free-hand.

The "working sketches of tools and of joints" are made in the manner described for "views" of cubes in connection with the Fifth Grade.

The "sections of solids" are to be drawn with ... views: the sections are to be of three kinds—cross, l... tudinal, oblique. Use the solids of the Fifth Grade.

THIRD GRADE.—In the circular border the ornam... tion should not be so minute as to require many repeti... of a unit.

MECHANICAL DRAWING.

SUGGESTIONS.

The leading point in this branch of drawing is accuracy; hence the necessity for great care in the selection and management of the instruments to be used. The drawing instruments to be used by the pupils in the Manual-Training Course are the following: ruler, triangle, square, compasses, scale, protractor. The use of each of these is to be taught as it is introduced, in its turn, into the mechanical drawing; the methods of testing the accuracy of these instruments must also be taught. In the lowest three grades the ordinary graduated ruler will serve sufficiently the purpose of a scale. The protractor should not be placed in the hands of the pupils prior to the Fifth Grade.

Each pupil should be provided with two pencils—one sharpened to a conical point, for making dots; the other, to a chisel edge, for drawing lines.

The varieties of lines used in mechanical drawing—full,

ed, dashes, dash and dot, dash and two dots—are to aught as the need for them may occur.

arallel lines should be so used as to give different tints shades—light, medium, dark: graded tints will be ded to indicate the surfaces of a cylinder.

The "working drawings" are the same in principle as e "working sketches," but they require the greater acracy resulting from the use of drawing instruments.

The applications of geometrical problems and the graphic olutions of the theorems require very accurate representaions: hence, the drawing is to be done by mechanical neans.

The truth of the enunciation of a problem, and the accuracy of the work of its graphic solution, may be shown by cutting out the diagram when complete, dissecting it, and then comparing or combining the parts. For instance, in Theorem 2, Fifth Grade, draw the isosceles triangle, cut out the diagram, cut apart the angles at the base, and compare them by superposition.

The problems and theorems recommended for the several grades are given below.

EIGHTH GRADE.—1. To bisect a given line.
2. To erect a perpendicular to a line at its middle point.
3. To erect a perpendicular to a line at any point.
4. To erect a perpendicular to a line at any point (2d method).
5. From a given point, to draw a perpendicular to a line.
6. Through a given point, to draw a line parallel to a given line.
7. To construct a triangle with given sides.
8. To construct a triangle similar to a given triangle.
9. To divide a line into a given number of equal parts.
10. To make an angle equal to a given angle.
11. To construct a parallelogram when an angle and the adjacent sides are given.
12. To make an angle of 60°.
13. To bisect a given angle.

14. To make an angle of 30°.
15. To make an angle of 45°.

SEVENTH GRADE.—1. To draw a line that will bisect the angle by prolonging two given lines.
2. To bisect a given arc.
3. To find the centre of a circle.
4. To find the radius of a given arc of a circle.
5. With a given radius, to describe a circumference through two given points.
6. To describe a circumference through three given points—not in the same straight line.
7. With a circle, to circumscribe a triangle.
8. With a circle, to circumscribe a square.
9. With a circle, to circumscribe a rectangle.
10. With a circle, to circumscribe any regular polygon.

SIXTH GRADE.—1. To draw a line tangent to a circle, at a given point on the circumference.
2. To draw a line tangent to a circle, from a point without.
3. To draw a line tangent to two circles.
4. To describe a circle tangent to a given circle. Two cases.
5. In a circle, to inscribe a regular hexagon.
6. In a circle, to inscribe an equilateral triangle.
7. In a circle, to inscribe a square.
8. In a circle, to inscribe a regular octagon.
9. To inscribe a circle in a triangle.
10. To inscribe a circle in any regular plane figure.

FIFTH GRADE.—1. If two lines intersect each other, the vertical angles are equal.
2. In an isosceles triangle the angles at the base are equal.
3. The sum of all the angles formed around a point, on the same side of a given line, is equal to two right angles.
4. The sum of all the angles formed around a given point is equal to four right angles.
5. The sum of all the angles of a triangle is equal to two right angles.
6. A perpendicular is the shortest distance from a point to a line.
7. A line perpendicular to one of two parallel lines is perpendicular to the other.

FOURTH GRADE.—1. Parallel lines intercepted between parallel lines are equal.
2. If two parallel lines are intersected by a third line, A. the alter-

nate angles are equal: B. the exterior angle is equal to the interior opposite angle on the same side of the cutting line: C. the sum of the two interior angles on the same side of the cutting line is equal to two right angles.

3. Any parallelogram is equal to a rectangle of equal base and equal altitude.

4. A parallelogram is equal to any other parallelogram of equal base and equal altitude.

5. A triangle is half a parallelogram of equal base and equal altitude.

6. A triangle is equal to any other triangle having an equal base and equal altitude.

7. A square is equal to half the square on its diagonal.

THIRD GRADE.—1. A parallelogram is bisected by its diagonals.

2. The diagonals of a parallelogram bisect each other.

3. The diagonals of a rhomb intersect each other at right angles.

4. The area of a trapezoid is equal to the rectangle of half the altitude and the sum of the parallel sides.

5. The square of the hypotenuse of a right-angle triangle is equal to the sum of the squares of the other two sides.

6. An angle at the circumference of a circle is half an angle at the centre, standing on the same arc.

SHOP-WORK FOR BOYS.

FIFTH GRADE.

USE OF THE KNIFE.

How the knife cuts. The knife is a wedge, which pushes the wood aside. How sharpened. Use of the grindstone; of the oil-stone.

Precautions against accidents with the knife. Hand not to be placed in front of the knife while cutting. Knife not to be carried about the shop while open.

Cross-cutting with knife, on thin pieces, as splints. ercises in cutting splints for patterns involving only ri angles with butt-joints, as squares, rectangles, Gre

·oss-cutting and paring. Lap-joints. Square frame, \t 3 inches square, of one-fourth inch pine, half-lapped he corners. The same with extra pieces half-lapped \e middle of the sides. (See Fig. 1.) Drawing to be le of given dimensions, from a model, and object to made from the drawing.

USE OF THE JACK-PLANE.—Sketches of plane and plane-ns; mode of action. Form of cutting edges. Mode of inding; of sharpening. Slopes given by grindstone and \-stone. Form and use of the back-iron or "cap"; ad-ıstment of the cap.

Planing the edge of a three-fourth inch board about four eet six inches long and 7 inches wide. Use of the *bench-vise*; mode of action of the vise. Sketches of the vise in plane and elevations. Planing against the grain; with the grain. Making the edge square; use of the try-square. Making the edge straight by eye; by straight-edge. Finishing with the grain, with plane set fine.

Planing the face of the piece. Use of the *bench-dog*. Making the face straight. Testing for winding; planing off the high corners. Supporting the high corners while planing.

Marking standard surfaces and standard edges; working always from these.

Planing second face parallel to the first. Use of gauge. Adjustment of gauge; proper manner of holding and using it. Finishing first and second surfaces with plane set fine.

Reducing pieces to proper width and making second edge parallel to first. Marking with gauge and use of *draw-knife* if much wood is to be removed. Scoring and paring with the draw-knife.

Properties of wood. Unequal strength in different directions.

FOURTH GRADE.

Use of the Cross-cut Saw.—Marking off one inch fr... the end of the board last used. Holding in the vise a... sawing off one inch. Explanation of mode of action ... saw. Proper holding and movement of the saw. Pro... placing of the saw, so as to cut up to the mark but not b... yond. Care to avoid splintering the piece. Testing t... cut for squareness in both directions. Ascertaining t... amount wasted by the saw-kerf. Cutting off other piec... till a fairly good cut is obtained.

Working sketch and working drawing of a box to b... made from the piece last prepared.

Laying out the work. (See Fig. 2.) Allowance for saw-kerf. Square always to be applied to the standard face and edge. Explanation of reason for this. Illustration, with tapering pieces, of the effect of the contrary practice. Planing up tapering pieces of 1½ inch pine about 6 inches long for this illustration; to be afterward used for other exercises.

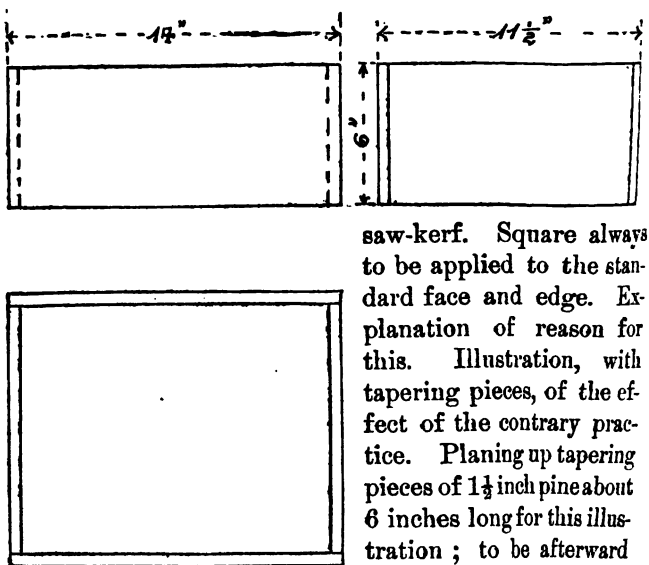


Fig. 2.

Cutting off the pieces with cross-cut saw. Testing the ces. Standard surfaces to be marked on each piece.

HAMMER AND NAILS.—Driving nails into waste pieces; ong way and right way for practice, the former splitting e wood. Proper holding and swinging of hammer. ailing pieces together to form a box. Testing the box or squareness and winding.

Taking the box apart. Drawing and straightening nails. Reducing size of box and putting together again. Qualities of different woods; pine, white-wood, oak, etc.

USE OF THE CHISEL.—Oblique paring. The tapering stick used in the Fourth Grade, first term, is to be planed true. Drawing of stick terminated by a square pyramid at one end and a semi-cylinder at the other, from given dimensions. Work to be laid out and executed from the drawing. (See Fig 3.)

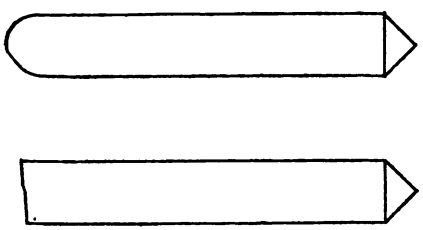


FIG. 3.

Proper mode of holding and moving the chisel. Sliding movement. Precautions against accident. Sharpening. Tool to be kept sharp. Similar stick to be pared to form octagonal prism terminating in octagonal pyramid. Position of the lines drawn on the faces of the square prism to determine the edges of the octagonal prism to be formed from the drawing of the octagon inscribed in the square.

Same stick to be pared to cylindrical form for half its length and terminated by a cone.

Other exercises designed by teacher and pupils.

THIRD GRADE.

Use of Chisel and Gouge.—Paring to plain and perpendicular surfaces. Rough stick, two inches square, six or eight inches long, to be pared smooth and exact square. Sliding motion of the chisel.

Chamfering. Model shown. Drawing to be made from

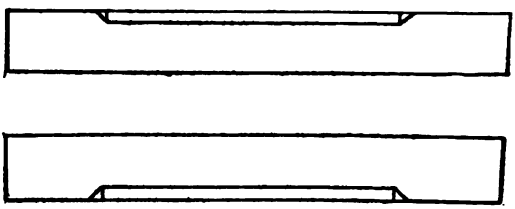


Fig. 4.

dimensions either given or taken from the model, chamfer laid out with *pencil* from the drawing, and cut exact, first with inclined plane ends (Fig. 4); second (on another edge), with ogee ends (Fig. 5).

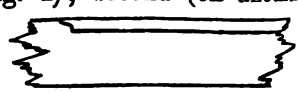


Fig. 5.

Gouge. Cutting concave surfaces. A grooved recess in one side of a square stick.

Use of sections in working drawings.

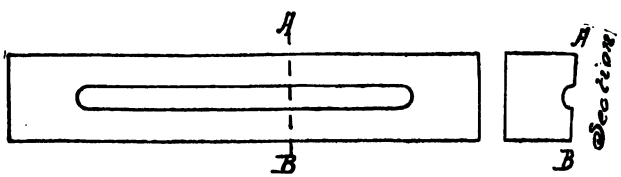


Fig. 6.

utting a coved moulding in one
e of a square stick. (See Fig. 7.)
laking one ogee moulding on one
e of a square stick. (See Fig. 8.)

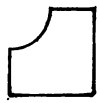


FIG. 7.

FIG. 8.

n each case the drawing first, then the laying out of
e work, then the work itself.

USE OF THE RIP-SAW.—Explanation of difference be-
ween rip-saw and cross-cut saw.

Cutting square strips about 12 inches long from two-
nch white-wood plank. Allowance for kerf. Cut to be
nclined to the length of the stick. Stick to be reversed
requently during the cutting.

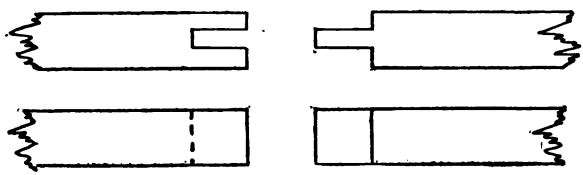


FIG. 9.

Four pieces to be cut out and planed true, 2 inches square. Attention to standard surfaces.

Making a lap or "half-lap" joint as in Fifth Grade, second term, but with saw and chisel instead of knife.

Working drawing to be made to scale, from measurements taken from model. Laying out work from drawing, with gauge, square and pencil. Cutting out with rip-saw and "back-saw." Explanation of difference between back-saw and common cross-cut saw.

The surfaces of this and of all other joints should come "flush" without finishing up. The work when finished should show the lines of the laying out, half the breadth of each pencil-mark remaining.

End mortise or scarf. (See Fig. 9.) Explanation from

model, showing the two pieces put together lengthwise perpendicularly. Working drawing to scale, or free sketch from measurement of the model. Laying out the drawing with gauge, square and pencil, using the ends of the pieces used in the preceding exercise.

EXPLANATION OF CENTER-BIT.—Study of its action. Manner of sharpening it and keeping it in order. Practice in boring with center-bit in waste wood. Care to avoid splintering. Use of center-bit in cutting out the mortise-piece of the mortise and tenon joint.

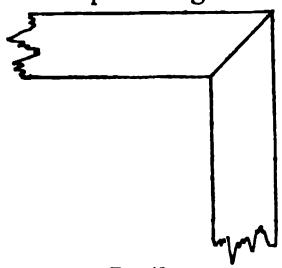


FIG. 10.

Mitre-joint. (See Fig. 10.) Stock of $\frac{3}{4}$ inch or $\frac{1}{2}$ inch pine or white wood, about 4 inches long. Setting the bevel. Laying out. Cutting off on the "bench-work." Testing the cut with square and bevel. Putting together with brad-awl and finishing nails. Hand-screws; adjustment or "setting" of hand-screws. Holding both pieces in hand-screw while nailing.

SECOND GRADE.

End dovetail. (See Fig. 11.) Drawing from model and measured dimensions. Laying out. Cutting out with rip-saw, back-saw and center-bit; finishing with chisel.

Side dovetail. (See Fig. 12.) Drawing, laying out and cutting out as above, excepting the use of the center-bit.

Oblique side dovetail. (See Fig. 13.) Drawing, laying out and marking as in the last exercise.

Gluing. Preparation, care and use of glue. Some of the joints may be glued together and finished up with the

e **when dry.** This is not to be encouraged generally, removes the evidence of bad workmanship in the fit of the joints.

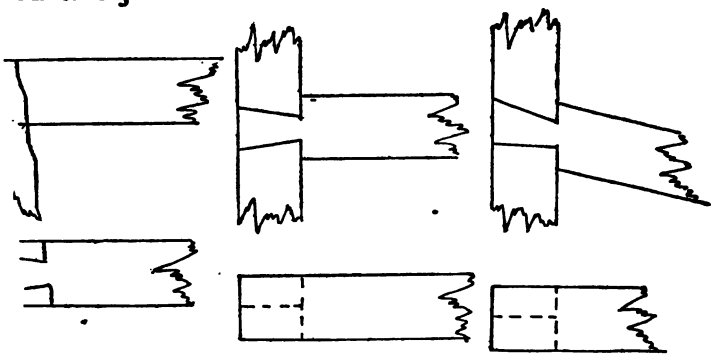


FIG. 11. FIG. 12. FIG. 13.

Through Mortise. (See Fig. 14.) Drawing from model, ying out, cutting out with back-saw, rip-saw, center-bit ıd chisel. Cutting half through from each side, to avoid olintering.

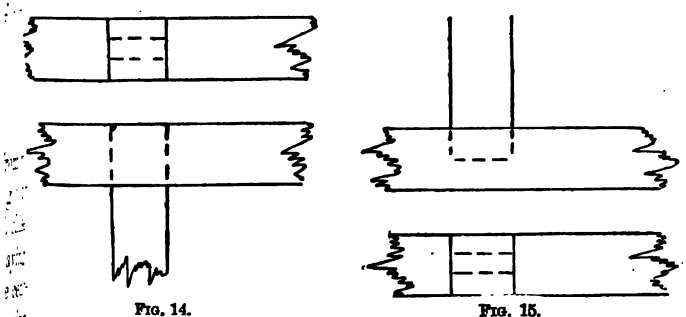


FIG. 14. FIG. 15.

Stub-mortise. (See Fig. 15.) The same kind of operations, except that the mortise is only cut half-way through.

One of these mortises may be cut without the cente
Explanation of the mode of using the chisel in this

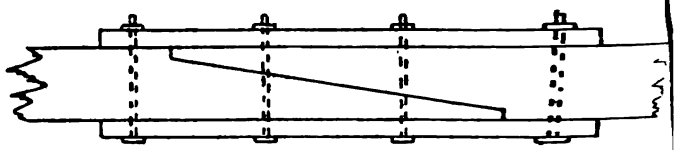


FIG. 16.

Oblique scarf joint. (See Fig. 16.) Drawing and
ing out as above.

Boring with gimlet-bit, putting together with bolts
wrench. Explanation of the use of such a joint. *K*
scarf joint. (See Fig. 17.) Same processes as ab

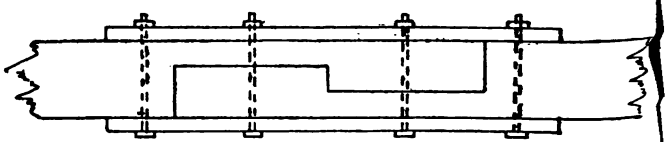


FIG. 17.

Explanation of the use of such joint. Some pupils ma
make this joint and others the last.

FIRST GRADE.

Dovetailed box. (See Fig. 18.) Detailed drawing from measurements of model, full size. Material from the nailed box made in the fourth grade. Cutting out, planing up pieces true to given dimensions. Finishing smooth. Laying out the work; numbering the corresponding corners. Marking the waste pieces, to prevent mistakes. Cutting out with dovetail saw and narrow chisel. Fitting

ether; testing for squareness, winding, closeness of its.

Preparation of glue. Proper setting of hand-screws. ding the box together. Preventing the glue from

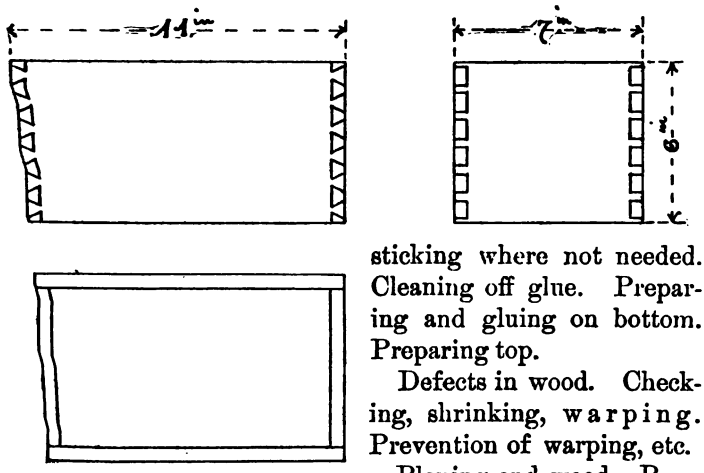


Fig. 18.

sticking where not needed. Cleaning off glue. Preparing and gluing on bottom. Preparing top.

Defects in wood. Checking, shrinking, warping. Prevention of warping, etc.

Planing end-wood. Practice with jack-plane on waste pieces. Same with smoothing-plane. Proper setting of plane iron. Prevention of splitting or splintering.

Cleaning up box with smoothing plane. Care to preserve the figure of the box. Squareness. Winding.

Hinges. Marking for hinges. Cutting out. Cut must be of exactly the right depth. Screwing on hinges. Use of brad-awl and screw-driver.

Fitting a hook to the top. A few best workers may fit a hook. Marking out for hook. Marking and boring for key-hole. Cutting out for lock. Fitting the hasp. Finishing the edges of the top.

Sand-papering. Finishing with shellac.

COOKING.

THIRD GRADE.

General Notes.

Materials—Materials which compose the tissues of human body: table of compound elements; of chief elements. Water the chief constituent. How these sues are constantly in process of wasting—effects of cular action, voluntary and involuntary, thinking, etc.

Repair—The wasting of the tissues makes food necessary. How the tissues are constantly renewed, repaired sustained.

Alimentation—The food must contain the same ments as those which are being lost from the body.

Cooking—Few solid materials, excepting certain fruits are naturally ready for digestion and assimilation. Cooking prepares for digestion, is a kind of preliminary partial digestion, especially of many vegetable substances. must also make food palatable.

Nutriment—Nutritive value of different kinds of foods—largely dependent upon cooking. Elements supplied from vegetable foods—from animal foods—chief vegetables that supply a certain element, such as starch, sugar, sulphur, lime, etc.

The Four Compound Groups—The mineral group—water, salt, etc.; the starch and sugar group; the fats group; the albuminoid group.

Nutritive value not dependent alone upon the quantity of one or more elements, but rather upon the combination of several elements.

Compound foods generally the most nutritious.

amples : *Milk*—chief of natural foods—contains r, sugar, butter, caseine, various salts, etc.; *bread*—f of cooked foods—contains water, sugar, starch, en, phosphate of lime, etc.

The four chief chemical elements of food—Carbon, hygen, oxygen and nitrogen.

Related Facts, Physical and Chemical.

Heat—practical sources of for cooking—kinds of fuel wood, anthracite, bituminous coal, charcoal, gas.

What combustion is.

Effects of heat on water—*boiling*—temperature of boiling water at sea level in open vessel—less at elevations—why—temperature at "simmering"—popular mistake about this—what becomes of the added heat—practical uses of this knowledge. How temperatures higher than 212° may be obtained—when necessary or useful—effects of tight or heavy lid—of a closed vessel—why a vessel no longer boils over on removing the cover—effects of a strong solution of salt upon the boiling point: temperature of steam—practical uses of these facts.

High temperatures of flames—effects of draught in increasing them—moderate white heat, 1,300°—(a poker put into a kitchen stove fire will often show more than this)—melting point of iron, 2,786°—blast furnace, 3,300°—what the "clinkers" in a fire chamber tell.

Physical effects of heat on the albumen of eggs; on that of flesh; on starch; on the gluten of bread; proper temperatures for various purposes.

Effects of boiling as applied to fresh meats—to meat for soups—to salt meat—effects and changes previously wrought by the salt, or, how salted flesh or fish differs

from fresh—boiling as applied to vegetables—when st... ing is preferable.

General principles of baking, roasting, broiling, fr... etc.

Chemical effects of overheating—on bread—what bur... or badly scorched bread has become—effect on other i... —special effects on fats, particularly in frying; the dec... position produces a very acrid substance, *acroleine:* inj... ous effects upon the stomach.

Principle of raising bread, biscuits, etc.—air or carbo... acid set free, and expanded by heat.

Baking powders—their proper ingredients—cheapn... and poisonous effects of those containing alum—carbo... acid directly set free from the chemicals and retained i... small bubbles by the gluten. *Yeast*—what it is—simp... account of the growth of the yeast-plant; changes wrough... by it in the *sugar* of the flour—products—alchohol and car... bonic acid—alcohol escapes in baking—carbonic acid form... the vesicles—why bread or cake "falls" in the oven if the heat is not properly maintained.

Leaven—what it is—how it acts.

Effects of boiling water on yeast or leaven.

What causes the crust of pastry to be light and flaky.

How eggs may make cake "lighter."

Food of infants—of convalescents.

Avoidable causes of dyspepsia.

The Germ Theory—its importance—why milk and certain cooked foods sour and ferment: why flesh and fish spoil; why fruit decays. Effects of cold or ice; of heat; of salt, sugar, borax, salicylic acid, etc., in preserving food.

Apparatus—stoves, ovens, etc.—care of drafts and dam... Lined ovens. Importance of keeping all clean, in... d out. *Utensils*—absolute cleanliness indispensa-

-care necessary when vessels of iron, tin or copper used—effects of iron on tea and coffee—of acids and on copper—verdigris—the condition of water that has for hours in a lead pipe—dangers of old plumbing; lth and even life often dependent on a knowledge of se things.

Purchasing food—discrimination as to wholesome and wholesome; how to know fresh vegetables—fresh meats; sh eggs; limed eggs; young poultry; to distinguish mb from mutton; fresh fish; when salted beef has been operly cured.

The choice of parts—the butchers' names for parts of an x—how to know good beef—the choicest parts of a poor nimal are inferior as food to any part of a good animal.

METHODS AND PRACTICE IN COOKING, involving simple practical applications of facts and principles taught.

SECOND GRADE.

As in Third Grade.

SEWING.

SUGGESTIONS.

EIGHTH GRADE.

Use blackboard to illustrate stitches as in primary grades. See that each girl's work is rolled up by itself and marked distinctly. The teacher must now insist that the stitches shall be made small as well as even.

As a review of the work of Primary Grades, it would be well to have each pupil make a thimble bag of white

ing the ends about two threads deep. Commence the on-hole stitch at the bottom of the left side. This :h is made by passing the thread around the needle :r it is in position for drawing through the cloth. tches should be close and even, one thread between h stitch and the following one. Four stitches should taken at the end for strength.

Sewing on buttons—Use double thread, concealing the ıot under the button: let two stitches be then taken :ross both ways, making lines on the wrong side; then ass the needle several times through the button. To ıish off, let the thread be wound around the button, and fastened with two stitches on the wrong side.

Patching—Calico or striped muslin is useful for this. Cut the hole even by the thread: the pieces to be put in should be larger than the hole. It must then be taken from the inside and fastened on corner of hole, running it in except at the corners, where back stitches should be taken. In turning the corner, a little notch must be made with the scissors close to the stitches, to prevent drawing, and to make the corner pointed. The seam should then be felled down.

SIXTH GRADE.

Herring-bone stitch.—This stitch is used specially for sewing down flannel seams and for flannel patching.

The stitch is commenced at the left, which is the opposite end of the work to that at which all other sewing begins. Fasten the thread at the top of the seam, by a small stitch; then bring it down about a quarter of an inch, slanting it to the right; make then another small stitch—cross the thread and bring it back to the top.

The stitches at the top and bottom should be a q... of an inch apart, and so placed that each of those o... lower row will be directly under the middle of the ... space between two of those of the upper row.

Darning stockings.—For this stitch get the childre... bring old coarse stockings from home; use darning co... and needle. Trim off the edges of the hole, pass ... thread under the end of the hole, then with it go ba... and forth from top to bottom, taking up woven stitches ... the stocking, and running into the stocking about a qua... ter of an inch. Then from side to side pass the thread, taking up alternately one of the end to end threads, ... weaving the threads at the centre. Tears and cuts shou... be treated in much the same way.

FIFTH GRADE.

Work of previous grades reviewed, and followed by *Tucking*. Great care should be exercised in creasing the tucks. A piece of paper should be cut with a notch of the same size as the proposed width, the muslin be laid on the desk or a slate, and folded over with the paper to designated width. Crease the fold with the nail of the right-hand thumb; then with fine running stitches sew the fold. Turn it over and with forefinger scratch the sewing on wrong side, which will lay the tuck down smoothly.

Gussets.—Are specially used in finishing off gentlemen's shirts. Take a two-inch square piece of muslin, cut it into two equal triangles; turn down rough edges of one of these triangles, called a gusset, also the edges of the seam into which this gusset is to be placed. Take the middle corner of the piece and fit it to where the sewing of the

has stopped. Overhand it down half an inch each with small stitches. Turn the gusset over on the ıg side of muslin and hem it down neatly.

FOURTH GRADE.

A system of taking measures upon geometrical ideas is e introduced. Also, with use of blackboard for illustions, paper patterns of waists and undergarments are t and afterward fitted to figure. In this grade the principle of drawing from scale and measurements will find practical application.

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